SAVE WITH AIR!

Find out

NEW FREE BOOKLET
tells how you can profitably apply air power

- To speed up operations
- To handle materials more efficiently
- To reduce power costs
- To spray, clean, paint, etc.

Believing that many plant operating men do not fully realize the many applications of air power cylinders, hoists and compressors, Curtis Pneumatic Machinery Company has prepared a new 28-page booklet which gives a summary, by industries, of the most successful uses for air. This information is compiled from Curtis' 44 years' specialization in the air power field, and from surveys made by an industrial research organization.

Check Uses Against Your Own Plant—There is no cost or obligation in sending for this book, yet it may result in an important saving or improvement for your plant. You owe it to yourself and your company to get this data. See if air power can help *you*. If there is a possible application, Curtis engineers will then be glad to check into it (still with no obligation, of course) and make recommendations.

Send the Coupon—While you think of it, mail the coupon below. It may mean a real step forward in increasing your plant efficiency, and you are sure to learn new uses for modern air power—the field in which Curtis has earned an enviable reputation for dependable equipment.

CURTIS Compressors • Air & Hydraulic Cylinders
Air Hoists • I-Beam Cranes & Trolleys

CURTIS PNEUMATIC MACHINERY CO.
1917 Kienlen Avenue, St. Louis, Mo.

Gentlemen: Without obligation, please send your new 28-page free booklet, "How Air Power is Being Used in Your Industry."

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AUTOMOTIVE INDUSTRIES
The AUTOMOBILE

Reg. U. S. Pat. Off.
Published Weekly

Volume 78 Number 6

JULIAN CHASE, Directing Editor
HERBERT HOSKING, Editor
P. M. HELDT, Engineering Editor — J. B. POLLOCK, Ass't Editor
JOS. GESCHELIN, Detroit Technical Editor — GEOFFREY GRIER, Art Editor
J. A. LAANSMA, Detroit News Editor — MARCUS AINSWORTH, Statistician
JEROME H. FARRIS, Ass't Editor — L. W. MOFFETT, Washington Editor
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AUTOMOTIVE INDUSTRIES

February 5, 1938
Vol. 78, No. 6

Production Still Paced by Orders

Used Cars Target for Concentrated Merchandising Efforts With Factories Developing Special Selling Programs

Car and truck manufacturers began February as they ended January with production realistically determined by orders received from their dealer organizations. With schedules almost universally established on a week-to-week basis there are few who will venture an estimate on what this month's total production will be.

Consensus of opinion, based on the present operating schedules, is that the industry will finish the month with about 200,000 new cars and trucks coming off the lines.

Factories and their entire distributing organizations are leaving no stone unturned in their attack on used car inventories. Although reports from the field are mixed there is evidence that continued selling effort combined with bargain prices is beginning to produce results. All factories have developed special used car merchandising programs to help their dealers, while dealers in turn, through their associations and individually, are emphasizing the unusual values now available. Newspapers in many sections of the country are playing an important part in getting this message to the public.

Production during the first week of February is expected to be slightly under that established during the last week in January and the pace established this week probably will hold for the rest of the month although output of individual producers may vary from time to time.

The industry continues to be encouraged by sales in the export and truck fields, which are holding up in satisfactory volume and with reports from dealers that a break in used car inventories will permit them to make trades for new cars, looks forward to an improved production situation during March.—J.A.L.

Labor

UAW Wants Chrysler Contract Parleys to Start Feb. 15

Negotiations for renewal and "possible revision" of the contract between United Auto Workers Union and the Chrysler Corp., will begin on Feb. 15 if the corporation accedes to the request of the union to begin discussions at that time.

Delegates representing the Chrysler UAW locals met in Detroit on Jan. 29 and suggested that date as the one on which they would like to begin consideration of a new contract to replace the one which expires on March 31. A six-man negotiating committee has been appointed to represent the union to be headed by R. J. Thomas, UAW vice-president in charge of Chrysler. A ten-man advisory committee, representing each of the Chrysler locals, also has been named to consult with the negotiating committee.

While representatives of the union have held informal discussions with General Motors officials recently no decision has yet been made on a date for beginning of actual negotiations for revision of the GM-UAW contract. Union headquarters reported that a date for opening of negotiations probably would be suggested this week.

Dominated almost entirely by the CIO and UAW the Michigan Labor Non-Partisan League was established on a provisional basis in Lansing on Sunday, Jan. 30. A few scattered AFL representatives were present but none of them were prominent officials. AFL leaders, in fact, disclaimed any interest in the meeting, and William Green, AFL president is said to have proposed that his union withdraw from the league, labeling the league as a "ventrilo-

(Turn to page 165, please)

ALEXANDER C. FAEH

Al Faeh Dies

Automobile Accident Fatal To Well Known Show Manager

Alexander C. Faeh, better known to his many friends in automobile circles as "Al," was killed last week in Chicago when his automobile crashed head-on with a street car. Mr. Faeh was general manager of the Chicago Automobile Trade Association and manager of the annual automobile show sponsored each year by the dealers of Chicago.

Faeh, who was 57 at death, first came into the automobile business as membership secretary of the Cleveland Automobile Club. He was advertising manager for the Owen Magneto Co., Cleveland, and later held the same position with the Rausch-Lang Electric Co.

In 1931 and 1932 he was manager of the Chicago Automobile Trade Association; resigning, he spent a year in special work. He returned to the C.A.T.A. in August, 1934, to stage the February, 1935, show, and after the show was reinstated as manager of the Association.

National Show Date Set for Nov. 11

Automobile Manufacturers Association Directors Vote Change After Careful Review of Sales and Labor Factors Involved

After a careful review of the sales and labor factors involved, directors of the Automobile Manufacturers Association, at their meeting in Detroit, Feb. 2, voted to defer the National Automobile Show from October to November, with the opening on Armistice Day, Friday, Nov. 11, matching the same day of the highly successful 1936 affair at Grand Central Palace, New York, instead of the October 27 date of last fall.

"Manufacturers advanced the date of the annual automobile show to the fall on the request of President Roosevelt after the industry had made its study of unemployment with a view to improving continuity of employment and annual earnings of its workers," reported Byron C. Foy, chairman of the show committee which includes Paul G. Hoffman and Richard H. Grant.

"Dealers have expressed varying opinions as to the proper time for shows, ranging from Sept. 1 to Jan. 15, but with all agreed that the show and the new model announcements should be coincidental and this could be assured only by the Nov. 11 opening at Grand Central Palace, which at the same time would give consideration to the stabilization program for factory workers."

As many of the truck companies have been unable to properly canvass the proposals for a truck show, the manufacturers in the AMA voted against the promotion of a national truck show this year.

It is recommended that the show committee make a survey and report before Oct. 1 whether the association should promote a national truck show in New York in 1939.

"Records show," said Alfred Reeves, AMA general manager and also manager of the national show, "that the November date is ideal insofar as working conditions in the plants are concerned.

"When the first fall show was held in 1935," he added, "factory employment from November to January was 6 per cent higher than normal and new car sales were good. In 1936, with the show opening on Armistice Day, factory employment from November to January was 14 per cent above normal and retail sales for the last quarter of the year were the best ever shown—while the used car situation was not bad.

"The drop in business which coincided with the 1937 show caught everyone by surprise, and dealers made trades without realizing that their used car stocks would pile up so rapidly. With this year's experience the industry feels that the situation after the next show will be different insofar as used car inventories are concerned."

S. L. DAVIS

. . . president of the Hupmobile Illinois Co., Chicago, who has been elected to the Board of Directors of the Hupp Motor Car Corp. Mr. Davis will fill the unexpired term of Arthur S. Dewing who has resigned.

GM Formally Opens Diesel Engine Plant
G.M. to Make Diesel Engines On Mass Production Basis
Mass Output of Diesels Begun by General Motors
G.M. to Produce Small Diesels
G.M. to Produce Junior Diesel
Industry Strides On!
DON'T you make the mistake of thinking that this "recession" or anything else can stop your country's onward march!
PROGRESS ON THE AMERICAN PLAN
GENERAL MOTORS

FORWARD!

This full page message from General Motors Corp. over the signature of the corporation's chairman, Alfred P. Sloan, was published in a number of metropolitan newspapers Monday, Jan. 31. Addressed to Mr. John Q. Public the institutional piece encourages optimism with "There may be halts, there may be setbacks, there may be temporary 'recessions,' but the instinct of American industry is progress."

Mallory Employes Receive Bonus

Mallory Electric Corp., Detroit, on Jan. 25 distributed to its employes bonus checks amounting to approximately 10 per cent of each individual employe's earning for the year 1937. About 140 employes benefited under this profit-sharing plan which the company set up a year ago.

Goodyear Changes Shift Hours

A change in shift hours in the Akron plants of the Goodyear Tire & Rubber Co. is viewed by organized labor as a possible forerunner of attempted reinstatement of the 8-hour day for Goodyear tire builders, and brought vigorous storms of protest from CIO leaders in Akron, Feb. 1.

The new Goodyear operating schedules lengthen the 6-hour shifts

by 15 min. with a 15 min. lunch period. Instead of second shift operators starting work the minute the first shift ends, the schedules now call for a gap from 1:15 p. m. to 3:30 p. m. before the second shift starts.

Under this program, first shift workers report at 7 a. m. and quit at 1:15 p. m. and second shift operators report at 3:30 p. m. and work until 9:45 p. m.

New Head for V-8, 85 Hp. Engines

Federal-Mogul Corp., Detroit, has brought out a new "thermo-flow" power head for service installation on Ford 1937-38 V-8 85 hp. engines. The redesigned head is cast from a special alloy which has high heat dissipating qualities and employs "spot and fin" cooling.

It is claimed that the new heads permit up to 20 per cent higher compression ratios, 15 per cent more power and 20 per cent more mileage.

Scherr to Handle Leitz Devices

The George Scherr Co., New York, has announced that it has taken up the exclusive sale of Leitz optical measuring precision instruments which include various sizes and styles of toolmakers' microscopes, large and small projection apparatus, microscopes for surface inspection and also some types for metallurgical purposes.

Spicer Patent Suit Dismissed

Dismissing a patent infringement suit brought by Spicer Mfg. Co., Toledo, (licensee) and others, against Universal Products Co., Inc., Dearborn, Mich., Federal Judge John P. Nields, Wilmington, Del., held that the Richard Gotz needle bearing patent is invalid.

Mr. Gotz, a German businessman, financially aided an inventor, George Hoffman, Darmstadt, who was granted a German patent on a needle bearing on March 13, 1924. An application was filed under Mr. Gotz's name in the United States on March 25, 1925, Mr. Hoffman having forfeited his right to apply in this country. However, the court found that Gotz added nothing of value to the Hoffman patent, and that the Gotz claim was invalid.

A.S.T.E. Sponsors Unique Show Scheme

Unique in the history of show and convention management is the move revealed this week by Frank A. Shuler, president of the American Society of Tool Engineers, which is sponsoring a Machine and Tool Progress Exhibition at Detroit's Convention Hall, March 9 to March 12, in connection with the society's annual convention.

Mr. Shuler announced that proceeds from the show were being assigned to local chapters of the A.S.T.E. all over the United States, in advance of the show, to aid them in bringing A.S.T.E. members from all over the country to Detroit.

"The Machine and Tool Progress Exhibition is already in the black . . .," Mr. Shuler reports. "We have decided to use the proceeds in making it easier for production men from all over the country, who are members of our society, to come to Detroit. The money will be paid to those who are coming at their own expense in the form of mileage rebates."

If Only Wisconsin Would Tell . . . .

Chevrolet Noses Out Ford in 1937 Passenger Car Registration Returns for 47 States; Ford Leads on Totals; Definitive Figure Impossible Lacking Wisconsin Data

New Passenger Car Registrations*

	December 1937	November 1937	December 1936	TWELVE MONTHS 1937	TWELVE MONTHS 1936	Per Cent Change, 12 Mos., 1937 over 1936	Per Cent of Total Twelve Months 1937	Per Cent of Total Twelve Months 1936
Chevrolet	45,180	57,095	78,836	758,206	919,748	− 17.5	22.03	27.33
Ford	30,721	15,071	61,680	758,069	740,249	+ 2.3	22.02	22.00
Plymouth	22,228	26,125	45,630	456,992	494,168	− 7.4	13.28	14.68
Dodge	10,567	14,345	23,150	252,339	245,478	+ 3.0	7.33	7.29
Pontiac	9,704	12,567	18,967	209,947	169,486	+ 23.8	6.10	5.04
Buick	14,853	18,056	21,104	202,859	159,147	+ 27.5	5.89	4.73
Oldsmobile	9,200	10,349	19,183	185,857	176,417	+ 5.2	5.40	5.24
Packard	4,976	5,588	7,392	94,653	67,859	+ 39.6	2.76	2.02
Chrysler	5,477	6,598	7,361	90,659	58,141	+ 56.0	2.63	1.73
De Soto	3,887	5,079	5,491	73,606	44,589	+ 65.0	2.14	1.32
Terraplane	2,908	3,567	8,007	73,433	77,589	− 5.5	2.13	2.31
Studebaker	3,429	4,030	6,428	69,269	66,992	+ 3.4	2.02	1.99
Nash	3,361	3,248	4,695	67,743	41,584	+ 63.0	1.97	1.24
Willys	1,911	2,453	1,121	50,838	12,406	+309.0	1.48	.37
La Salle	1,481	1,888	3,002	28,681	13,882	+107.0	.83	.41
Lincoln	1,988	1,404	2,027	25,047	15,386	+ 62.7	.73	.46
Hudson	1,268	1,267	1,853	15,654	20,614	− 24.1	.45	.61
Graham	772	561	1,438	13,822	16,245	− 14.9	.40	.48
Cadillac	628	611	1,360	11,149	11,684	− 4.9	.32	.35
Cord	14	40	85	1,146	1,170	− 2.1	.03	.03
Hupmobile	105	120		396			.01	
Pierce-Arrow	9	5	46	166	782	− 78.8		.02
Auburn		1	52	146	1,843	− 92.0		.05
Miscellaneous	133	117	695	1,441	9,963	− 85.5	.05	.30
Total	174,820	190,185	319,603	3,442,118	3,365,422	+ 2.3	100.00	100.00
Chrysler Corp.	42,159	52,147	81,632	873,596	842,376	+ 3.8	25.38	25.03
Ford and Lincoln	32,709	16,475	63,707	783,116	755,635	+ 3.8	22.75	22.45
General Motors	81,046	100,566	142,452	1,396,699	1,450,364	− 3.9	40.58	43.10
All Others	18,906	20,997	31,812	388,707	317,047	+ 22.4	11.29	9.42

* Does not include returns of Wisconsin since June, 1937. All data are on a comparable basis.

New Truck Registrations*

	December 1937	November 1937	December 1936	TWELVE MONTHS 1937	TWELVE MONTHS 1936	Per Cent Change 12 Mos., 1937 over 1936	Per Cent of Total Twelve Months 1937	Per Cent of Total Twelve Months 1936
Ford	7,712	4,508	11,700	187,187	175,086	+ 7.0	30.65	28.99
Chevrolet	10,323	8,191	14,500	181,212	201,903	− 10.4	29.68	33.43
International	4,292	4,948	5,511	75,279	71,036	+ 6.0	12.33	11.76
Dodge	3,480	3,807	4,311	63,304	84,247	− 24.8	10.37	13.95
G. M. C.	2,030	2,281	1,747	43,023	26,511	+ 62.2	7.05	4.39
Plymouth	690	711	41	13,413	2,387	+461.0	2.20	.40
Diamond T	365	383	735	7,973	8,534	− 6.5	1.31	1.41
White	320	406	423	5,903	5,707	+ 3.5	.97	.94
Mack	313	342	428	5,476	4,194	+ 30.7	.90	.69
Studebaker	182	179	209	5,065	3,235	+ 56.8	.83	.54
Terraplane	88	151	168	4,746	1,878	+153.0	.78	.31
Reo	250	192	290	4,166	4,170		.68	.69
Federal	94	121	228	2,322	2,892	− 19.6	.38	.48
Autocar	150	149	162	2,174	1,445	+ 50.2	.36	.24
Brockway	102	119	105	1,593	1,695	− 6.0	.26	.28
Indiana	58	74	144	1,365	1,692	− 19.3	.22	.28
Stewart	49	66	85	1,137	1,271	− 10.7	.19	.21
Diveo	26	43	53	1,113	963	+ 15.8	.18	.16
Willys-Overland	182	80	141	1,111	2,435	− 54.3	.18	.40
Stutz-Pak-Age Car	28	15		603			.10	
F. W. D.	23	28	45	431	333	+ 29.5	.07	.06
Sterling	10	14	30	309	270	+ 14.3	.05	.04
Kenworth	4	5		131			.02	
Schacht	1			41				
Miscellaneous	140	111	276	1,517	2,093	− 27.5	.24	.35
Total	30,912	26,924	41,332	610,594	603,977	+ 1.1	100.00	100.00

* Does not include returns of Wisconsin since June, 1937, but all data are on a comparable basis.

European photo

FINIS Speeding 275 m.p.h. along Germany's Frankfort-Darmstadt express highway, Bernd Rosemeyer (insert) met sudden death last week when a gust of wind caught his 16-cylinder rear-engined Auto-Union car and caused it to swerve off the road into a tree. Rosemeyer, winner of the George Vanderbilt Cup race at Westbury, L. I., July 5, 1937, was attempting at the time of the fatal accident to crack two world speed records.

The German racing driver, who was only 27 years old at death, won his first international victory in 1935 when he captured Czechoslovakia's Masaryk prize. During the year following he took six international first places: the German Eifel, the Italian Coppa Acerba, the Frieburg Mountain race, and the Grand Prix of Italy, Switzerland, and Germany.

In the photograph above, Rosemeyer is pictured testing his car on the recently rebuilt Avus raceway in Berlin, Germany.

Graham Starts Tractor Assembly

Graham-Paige Motors Corp. started assembly last week of its Graham-Bradley tractors for shipment to Sears, Roebuck & Co., which has placed an initial order for 2000 units.

The mail order house is handling domestic distribution of the tractor and, according to Graham officials, reports from the field indicate further orders. Sears is reported to have received more than 30,000 inquiries in reply to a mail campaign announcing the tractors.

Tire Prices Rebound

Mail Order Houses Kill 14% Cut Announced Last December

Leading mail-order houses which cut tire prices up to 14 per cent in their mid-winter flier catalogs, issued a month ago, have raised prices back to levels prevailing in their regular fall-winter catalogs. The new and higher prices are shown in the 1938 spring-summer catalogs which become effective March 1. The price increases vary on different sizes but are sufficient to restore price levels of last fall which were several per cent higher than mail-order prices of a year ago.

The new prices affect only tires sold via mail order and do not apply to retail store prices of the mail-order houses. These prices were not reduced when the mid-winter flier catalogs were issued. Mail-order first line retail store tires average between 90 and 92½ per cent of the average going price on first line tires of the industry. Top mail

MEN OF THE INDUSTRY

J. E. ANDRESS, president of the Barnes Drill Co., Rockford, Ill., was elected chairman of the board at the annual meeting of the Board of Directors on Jan. 25. **ALBERT M. JOHNSON,** with the company since its organization in 1907, and chief engineer for a number of years, was named president. Other officers named were **W. W. FAIRBAIRN,** first vice-president and works manager; **A. G. BLOCK,** secretary and treasurer. **RONALD S. WALKER** is domestic sales manager and **FLOYD A. SWANSON,** assistant domestic sales manager.

GEORGE CALLOS has been named assistant manager in charge of sales promotion embracing advertising, bulletins, exhibitions, house organs, etc., for the Allis-Chalmers Mfg. Co., Milwaukee, Wis. For the same company, **A. K. BIRCH** has been appointed assistant manager in charge of market analysis, sales organization service embracing price books, data and sales information, and the distribution of literature.

CHARLES R. HOOK, president of the American Rolling Mill Co., Middletown, Ohio, has been elected president of the National Association of Manufacturers for 1938.

E. T. CAMPBELL, formerly assistant manager of petroleum sales at the Akron, Ohio, headquarters of The B. F. Goodrich Co., has been transferred to New York City as assistant manager of petroleum sales in the eastern division. He succeeds **WILLIAM SEWALL,** recently named manager of the petroleum sales department with headquarters in Akron. **MORRIS A. STARR,** Atlanta, Ga., petroleum sales representative, takes Campbell's place as assistant manager of petroleum sales in Akron, and is in turn succeeded by **E. H. FITCH** as Atlanta representative.

W. L. GRANT has been appointed assistant advertising manager for General Motors Products of Canada, Ltd.

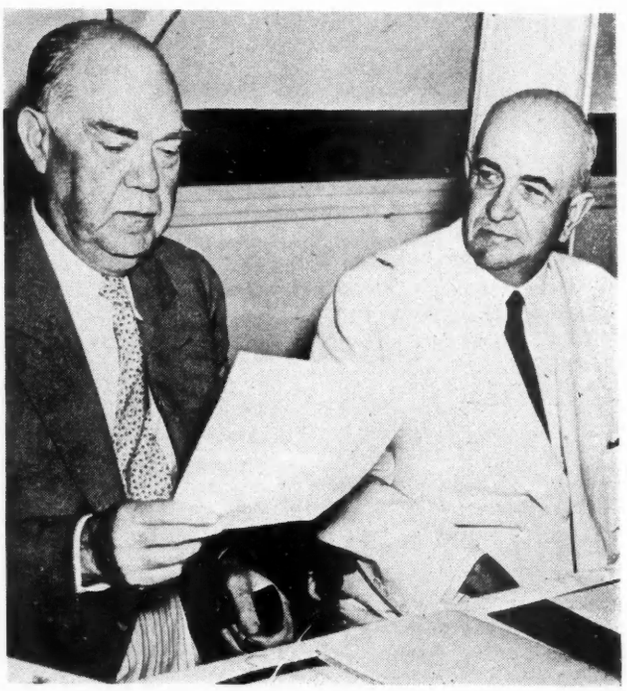
DAVID B. HILL has been named sales engineer specializing in foundry systems by the Chain Belt Co., Milwaukee.

C. H. PALMER, first vice-president, and **HOWARD T. BEIDLER,** secretary, have retired from the National Screw & Manufacturing Co., Cleveland. Newly appointed to the vacated positions are: E. E. Griese, now secretary-treasurer, and **C. F. NEWPHER,** vice-president and general sales manager.

EDGAR W. SMITH, General Motors Corp., export division, has been appointed to the Export Committee of the Automobile Manufacturers Association.

GLADIATORS

Charles M. Hayes (left) and Thomas P. Henry, respectively vice-president and president of the American Automobile Association, who are seeking legislation to abolish the Federal tax on gasoline and to increase the Federal highway appropriations. Hayes and Henry are pictured at the meeting of the Association's national executive committee, Miami, Fla.



Acme photo

order price under the new price increases will be at about 65 per cent.

While the industry ignored the mid-winter flier price reductions, the price cuts had the effect of softening the dealer market in many communities, and manufacturers have had increased difficulty during the past 30 days in maintaining their price stabilization program. The retail market should now firm-up considerably as result of the mail-order spring price advances.

Labor

(Continued from page 161)

quist's dummy for CIO." Purpose of the league, according to E. L. Oliver, of Washington, D. C., vice-president of the national league, is to defeat anti-labor candidates and to support pro-labor candidates. Homer Martin, UAW international president, was named chairman of the Michigan league pending a constitutional convention in June.

The National Labor Relations Board, in a decision handed down in Washington has ordered dissolution of the Bay Federation, an independent union of employes of an Electric-Autolite subsidiary in Bay City, the Bay Mfg. Co., following a hearing held last November on complaint of UAW. At that time the independent union claimed that it represented about 600 of the company's 1200 workers.

Five Million Car Radios in Use

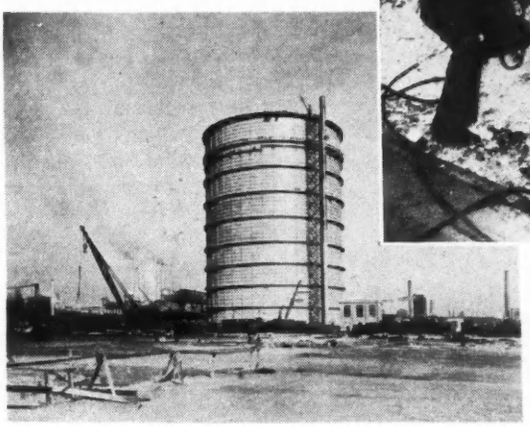
Automobile radios showed a gain of 1,000,000 units in 1937, according to a survey made by *Radio Today*. As of Jan. 1, 1938, about 5,000,000 automobile radios were in use, the study reported.

. . . slants

SAMPLE SYMPATHY—*According to a recent survey by the American Institute of Public Opinion, better known as the Gallup Survey, the general public is in sympathy with the Ford Motor Co. and against the UAW in their current litigation by* 66 *per cent to* 34 *per cent.*

Car owners are reported to favor Ford by 73 *per cent as against* 27 *per cent for the union; while non-car owners favor the manufacturer by* 54 *per cent to* 44 *per cent for the union. The survey found that majority sympathies of all population groups favored the manufacturer, excepting unskilled workers and persons on relief, which groups indicated sympathy with the union.*

EXPANSION The Ford Motor Co.'s $40,000,000 expansion program at the River Rouge plant includes the new 10,000,000 cu. ft. gas holder pictured below. The all-welded steel structure, 388 ft. high and 220 ft. wide, is virtually completed. It will be used to store coke-oven gas produced weekends when the plant is not in full operation. Gas will be taken from it as needed during the work week at a rate of one to two million cubic feet daily.



(Above) A workman in action atop the new 10,000,000 cu. ft. storage tank now under construction at Ford's River Rouge plant

Acme photo

Automotive Activity Across the Pacific

Anticipated Clash of Japanese Automobile Makers With Ford and GM Branches Postponed by China War Needs

The long-predicted clash between the Japanese branches of Ford and GM and the native motor industry has failed to materialize so far because of the extraordinary demand situation created by Japan's military operations in China, according to the *Nikkan Kogyo Shimbun*. During the six-months old war, there has been plenty of business not only for foreign and Japanese automobile manufacturers within the country, but the rapidly increasing military demand left a broadening margin to be covered by imports.

While Ford and GM are unable to expand their manufacturing operations beyond the limit set by the Motorcar Industry Control Law, Japanese licensed automobile manufacturers have made rapid strides recently. By the end of March their capacity will be 100 per cent above June, 1937.

Although it is admitted that in the low-price bracket Japanese makers are still unable to compete qualitatively with the Americans, high-priced car and truck models have already opened up a considerable market at the expense of foreign makes, says the *Nikkan Kogyo*. The vital problem is now a cut in production cost and improvement in quality in the popular-car field.

One reason why popular cars are still expensive is the lack of an effective sub-contracting organization, this paper reports. Because of lack of funds parts makers are compelled to confine their business to minor products which can be turned out with inexpensive equipment. The car manufacturers are thus obliged to make most parts in their own shops and spend large amounts on machinery which can only be utilized to a fraction of its capacity.

The Department of Commerce and Industry, Tokyo, has sent out questionnaires to the leading motorcar manufacturers in order to obtain data on the capacity of the principal parts makers. On the basis of this survey, the Commerce authorities will organize a group of sub-contractors which will enjoy special encouragement by the Government. It is intended to establish a cooperative body of licensed automobile manufacturers and parts makers with a view to unifying and standardizing the principal parts, which are now produced in a confusing variety.

Makers Oppose Manchu Project

Premier Konoye and Ministers of the Cabinet received a written statement of opinion, signed jointly by the Japan Traffic Society and the Im-

(Turn to page 169, please)

Business in Brief

Written by the Guaranty Trust Co., New York

There was a moderate improvement in general business activity last week. The weekly index compiled by the *Journal of Commerce* stood at 70.8, marking the third consecutive gain, as compared with 70.3 for the preceding week. The current figure is 26.9 per cent below that a year ago. Despite many restricting influences, retail trade continued to rise last week. The sales volume was from 1 to 3 per cent above that in the preceding week and from 2 to 5 per cent above that a year ago.

The index of business activity compiled by the Guaranty Trust Co. for December stood at 77.3, as compared with 81.1 the month before and 97.1 for the corresponding month in the preceding year. The company's index of wholesale commodity prices on Jan. 15 was 68.2, as compared with 67.4 a month earlier and 84.1 a year ago.

Railway freight loadings during the week ended Jan. 22 totaled 570,333 cars, which marks a decline of 10,267 cars below those in the preceding week and a decrease of 95,013 cars below those a year ago.

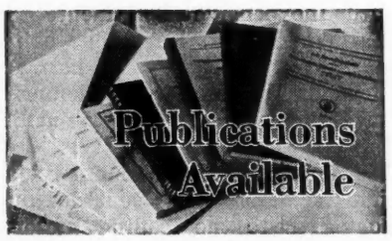
According to the Board of Governors of the Federal Reserve System, department store sales during December increased by approximately the usual seasonal amount. The Board's adjusted index for that month stood at 90, as compared with 91 in the preceding month and an average of 93 for the first 10 months of 1937.

Production of electricity by the electric light and power industry in the United States during the week ended Jan. 22 was 6.6 per cent below that in the period last year.

Farmers' cash income from marketings during December amounted to $675,000,000, according to the Bureau of Agricultural Economics. This figure compares with $713,000,000 in November and $725,000,000 in the corresponding month in 1936.

Professor Fisher's index of wholesale commodity prices for the week ended Jan. 29 stood at 83.1, as compared with 83.4 the week before, and 83.9 two weeks before.

The consolidated statement of the Federal Reserve banks for the week ended Jan. 26 showed no changes in holdings of discounted bills, Government securities, and bills bought in the open market. Money in circulation declined $52,00,000, and the monetary gold stock remained unchanged.



New models, new designs, and new features of the **"Fordair" compressor** are described in bulletin No. 3815 just released by Schramm, Inc., West Chester, Pa.*

Wilcox-Rich, division of Eaton Manufacturing Co., Detroit, has brought out a booklet describing the construction, operation, and advantages of its "Zero-Lash" **hydraulic valve lifters.** Clean-cut section drawings, photographs, diagrams, charts, and intelligently written text add up to make this booklet one of the finest pieces of technical trade literature recently brought to our attention.*

Latest publication published by the United States Steel Corp. Subsidiaries is entitled **"A Little Copper in Steel Gives a Lot of Protection."** It contains the results of the most recent American Society for Testing Materials' experiment at Annapolis on the atmospheric corrosion resistance of various grades of steel and iron.*

"AC Generators for Diesel Engine Drive," a 16-page booklet, and a folder describing the construction and application of the **Millite lighting unit** for the heavy industries are among the latest publications issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.*

The Heil Co., Milwaukee, Wis., has issued bulletin HB-937 which describes its "Straddle-Mount" telescopic **hydraulic hoist.***

"The Case for Freedom from Federal Control of Wages and Hours" is the title of a 24-page booklet analyzing the social and economic questions involved in federal wage and hour regulation, issued by the Machinery and Allied Products Institute, Chicago, Ill.

Latest bulletin, No. B-1, issued by the Haveg Corp., Newark, Del., describes the company's line of **cylindrical tanks, covers, and outlets.***

Maximum and rated performance curves of the seven current sizes of "Caterpillar" **Diesel engines** are included in a new booklet issued by Caterpillar Tractor Co.*

* Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

ICC Asks Comment on New Code

Second draft of part VI of the motor carrier safety regulations issued by the Motor Carrier Bureau of the Interstate Commerce Commission, governing the transportation of explosives and other dangerous articles by motor-vehicle, is being circulated to shippers and motor carriers for comment and criticism. The commission asks that contemplated comment and criticism be filed with the secretary not later than March 1.

GM Dispenses Savings

Employes' Investment Plan Yields $2,690,068 in Cash and Stock

General Motors began distribution this week of $2,690,068 in common stock and cash to its employes throughout the country, through its employes' savings and investment plan. In the present distribution, $1,582,418 was contributed by the corporation. The balance of $1,107,650 represents the amount paid in by employes.

This payment brings the total amount distributed to GM employes through the fund to more than $246,500,000 since the inception of this plan of organized savings.

The distribution is being made to the close of 1932, representing those employes who in the first four months of that year participated in the plan. Payments were made only for this period during 1932. Each participant who paid $100 into the fund during these four months, now receives a settlement of $243.55, consisting of cash and GM common stock, valued at $30 a share on the closing market price on Dec. 31, 1937.

The three remaining classes of 1933, 1934, and 1935 will mature at the end of the years 1938, 1939, and 1940, respectively. The plan, which was inaugurated in 1919, was suspended with the 1935 class because of uncertainty concerning legal requirements under the Social Security Act and the Securities Act of 1933.

Tocco Process for GM Diesels

Both the crankshafts and the camshafts of the new General Motors Diesel engines are reported to be hardened by the Tocco process which is controlled by the Ohio Crankshaft Co., Cleveland.

GM Reports Safety Record

General Motors Corp. has reported that 1937 was the best year in history for the safety of its plant employes.

Working more than 384,000,000 man-hours last year, employes met with only 5.15 lost-time accidents for every million hours they were on the job. Severity of the accidents was reduced to 0.652 days lost for every thousand hours worked.

Motor Wheel Units on Hudson 112

Motor Wheel Corp., Lansing, Mich., will manufacture wheel equipment for the new line of Hudson

motor cars, according to C. S. Holden, vice-president in charge of sales, who pointed out in a recent statement that "Motor Wheel has built wheels, hubs and brake drums for all vehicles produced by Hudson since the introduction of the company's 1923 models."

Canadian Trade Pact

Tentative List of Concessions Includes Axles and Parts

Automobile parts listed in the groups of products on which this country will consider granting tariff concessions in a new and broadened trade agreement with Canada are limited to axles and parts, axle bars, blanks and forgings, and all kinds of iron and steel chains.

The State Department, through its Committee for Reciprocity Information has fixed April 4 for beginning public hearings on the proposed agreement which will replace and broaden the one which has been in effect between this country and Canada for the last two years. Interested parties may submit their views in writing, the department announced, prior to March 12.

The department's formal announcement made this reference to axles:

"Axles and parts thereof, axle bars, axle blanks, and forgings for axles, of iron or steel, without reference to the stage or state of manufacture, not specially provided for, valued at not more than 6 cents per pound." Present rate of duty was listed as 6/10 cents per lb.

Also included were chain and chains of all kinds, made of iron or steel dutiable at 1⅛ cents per lb. on chains of less than ¾ and not less than ⅜ in. in diameter; and those less than ⅜ but not less than 5/16 in. in diameter, dutiable at 2⅛ cents per lb.

Motor boats valued at $15,000 or less, and agricultural implements and machinery are among the other items listed.

Agricultural implements already are on the free list but it is customary to include such products in trade agreement announcement. It is regarded as possible that the agreement may bind them to their present status in exchange for Canadian concessions.

Tire Shipments Total 55,446,668

Although producing nearly 3,000,000 fewer tires in 1937 than in 1936, due to heavy contraction of production schedules in the final quarter of the year, the tire industry shipped more tires last year than in 1936 and reduced its inventory position by about 3 per cent.

Total production for the year was 55,264,895 tires against 58,116,349 in 1936. Shipments were 55,446,668 against 55,362,739 in 1936.

December shipment figures for the industry show 3,153,402 units produced—a decrease of 16.4 per cent under November and a decrease of 37.1 per cent under December, 1936. December production was only 2,952,177 units—5.1 per cent less than in November and 44.4 per cent under figures for December, 1936. The figures are from tabulations of the Rubber Manufacturers Association.

December Truck Exports Led '36 Dollar Volume by 133%

Exports continue climbing rapidly with shipments of "Automobiles, parts and accessories" for December, 1937, passing the preceding month's total of $29,799,719 by slightly more than 33 per cent. For the 12 months' period ended December, 1937, exports in this classification were valued $346,848,333, an increase of roughly 44½ per cent as compared with the dollar volume for the same period in 1936.

Total commercial vehicle shipments registered another heavy surge forward in December, 1937, topping the 1936 dollar volume for this month by approximately 133 per cent. For the year ended December, 1937, total commercial vehicle exports amounted to $100,105,472, or about 83 per cent above the preceding year's volume.

	DECEMBER 1937		DECEMBER 1936		TWELVE MONTHS ENDED DECEMBER 1937		1936	
	No.	Value	No.	Value	No.	Value	No.	Value
EXPORTS								
Automobiles, parts and accessories		$ 39,710,176		$ 28,769,239		$ 346,848,333		$ 240,205,262
PASSENGER CARS								
Passenger cars and chassis	27,483	16,273,400	24,647	14,389,012	229,486	134,814,725	179,957	103,024,254
Low price range $850 inclusive	24,624	13,243,209	22,629	12,175,443	208,391	111,858,381	165,501	86,788,566
Medium price range over $850 to $1,200	2,403	2,289,741	1,650	1,561,036	17,754	16,789,385	11,758	11,238,283
$1,200 to $2,000	346	513,432	277	419,596	2,403	3,652,738	1,817	2,722,621
Over $2,000	90	226,937	91	232,937	938	2,514,221	881	2,274,784
COMMERCIAL VEHICLES								
Motor trucks, buses and chassis (total)	22,734	13,334,525	10,483	5,727,433	165,710	100,105,472	105,799	54,784,366
Under one ton	2,775	1,078,786	1,401	521,844	20,691	8,322,918	15,710	5,987,790
One and up to 1½ tons	16,509	8,469,602	7,156	3,377,086	109,457	54,421,741	71,305	32,890,323
Over 1½ tons to 2½ tons	1,915	1,496,470	1,445	1,301,272	24,821	19,578,188	13,849	10,550,312
Over 2½ tons	1,330	2,120,539	235	419,651	9,230	16,550,122	2,807	4,307,256
Bus chassis	205	169,128	246	107,580	1,512	1,232,503	2,128	1,028,683
PARTS, ETC.								
Parts except engines and ties		5,036,317		4,901,282		53,421,722		41,365,369
Automobile unit assemblies		3,273,526		2,200,675		38,276,643		26,529,397
Automobile parts for replacement (n.e.s.)		379,846		446,962		4,861,778		3,513,134
Other automobile accessories (n.e.s.)		517,473		405,439		6,498,088		4,607,481
Automobile service appliances								
Airplanes, seaplanes and other aircraft	57	1,406,100	115	2,002,364	629	21,036,361	540	11,313,201
Parts of airplanes, except engines and tires		1,960,107		416,508		12,157,337		6,060,483
INTERNAL COMBUSTION ENGINES Stationary and Portable								
Diesel and semi-Diesel	58	130,683	52	122,164	857	2,281,660	422	1,112,139
Other stationary and portable								
Not over 10 hp.	1,730	111,831	1,410	80,415	20,773	1,167,487	13,730	791,575
Over 10 hp.	109	85,868	119	73,997	3,238	1,616,795	2,193	1,001,883
Engines for:								
Motor trucks and buses	4,310	445,819	1,662	169,752	32,912	3,290,396	21,890	2,149,395
Passenger cars	7,229	505,174	7,376	514,003	82,578	5,563,751	48,154	3,305,862
Aircraft	79	510,616	160	1,061,252	1,047	5,944,004	945	5,397,469
Accessories and parts (carburetors)		219,822		161,754		2,753,525		1,940,517
IMPORTS								
Automobiles (dutiable)	106	52,249	94	58,065	1,949	1,158,424	1,075	558,979

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Foreign Notes

The Panhard Co. is using considerable aluminum in certain parts of its motors, thus reducing weight from 100 to 150 lb.

The alcohol manufacturers of Germany have employed a firm of competent chemists to decide upon the merits of alcohol as a fuel for motors. The tests will be made under the supervision of the government.

From *The Horseless Age*, April, 1898.

AUTOMOTIVE ABSTRACTS

German Army Truck Diesel

A standardized Diesel engine for all wheel-drive and other types of army truck has been developed for the German army. It is intended to be built in two sizes, the smaller developing a constant output of 75 and a peak output of 85 hp., while the larger is to have an output of 125 hp. The M.A.N. air-chamber combustion principle was adopted and it appears that most of the design work was carried out by the M.A.N. engineering staff, though engineers of other companies were called in for consultation. It may be explained that the M.A.N. engine has a trumpet-shaped combustion chamber whose axis makes an angle of about 55 deg. with the cylinder axis. To one side of the combustion chamber there is an air chamber that discharges its contents into the combustion chamber during the early part of the power stroke through three substantially horizontal orifices.

As regards the smaller engine, since it has to drive the radiator fan and the air compressor, it will have to develop a maximum gross power of about 90 hp., and a six-cylinder design of 4.13-in. bore by 4.72-in. stroke was chosen. Engine block and crankcase are a single iron casting into which are set "wet" cylinder liners. The cylinder head is in two castings, each covering three cylinders, and the oil sump is cast of light alloy. The cast iron liners are made of plain (unalloyed) cast iron and of rather heavy wall section, as it is planned to replace them when they are worn, rather than to regrind them, so as to obviate the need for new pistons and rings when doing a reconditioning job.

Pistons are of aluminum alloy and weigh, with their four rings, 2.46 lb. each. Connecting rods are of carbon steel, of uniform cross-section between the big end and the small end, and have the big end split at an angle so as to make it possible to withdraw them through the cylinder. This reduces the stress on the cap bolts. Hollow dowels are used at the joint between the connecting rod and cap to take loads in the plane of the joint. The weight of the connecting rod is 7.6 lb. of which the big end accounts for 5.5 lb.

The crankshaft has seven main bearings of 3.15 in. diameter and a bearing width of 1.61 in. It is fully counterweighted and provided with a torsional vibration damper. The firing order was made 1-2-4-6-5-3, which has certain advantages from the standpoint of torsional vibration, and the Bosch injection pump was so changed that it is not necessary to cross the oil pipes from the pump to the injectors with this timing. Main bearings are of lead bronze, the camshaft has four bearings. Inlet valves open 18.5 deg. before top center and close 31.5 deg. after bottom center; exhaust valves open 58.5 deg. before bottom center and close 18.5 deg. after top center. As the truck may have to operate at an inclination of as high as 30 deg., the dry sump system of lubrication was adopted. This is fully described in the article under review, as are the fuel injection system and other accessories. The article is to be continued.—*ATZ*, Jan. 10.

Suppressing Detonation

According to a number of Soviet authors quoted in *Chimie et Industrie* for December, the temperature of spontaneous ignition (and therefore the ignition delay and detonating tendency) of gas oils can be reduced not only by the addition of certain chemicals such as ethyl nitrate, which have a low ignition temperature themselves, but also by the addition of certain substances whose ignition temperatures are higher than that of gas oil.

Best results in suppressing detonation in compression-ignition engines were obtained by these investigators with ethyl nitrate. A curve of spontaneous ignition temperature vs. mixture proportion of gas oil-ethyl nitrate mixtures shows that the ignition temperature is lowest for 70 per cent ethyl nitrate.

Castor oil by itself has an ignition temperature in air of 1220 deg. Fahr., but when it is added to gas oil in the proportion of 10 per cent it reduces the ignition temperature of the latter from 1115 to 935 deg. Fahr., and an addition of 10 per cent of chloroform, which has an ignition temperature higher than 1220 deg., lowers the ignition temperature of gas oil to 824 deg. Fahr. It is thus seen that the law of proportionality does not apply to the ignition temperatures of fuel blends.

U.S. Cars Lead French Imports

During the first 10 months of 1937 French imports of motor vehicles and chassis included 972 complete passenger cars, 614 commercial vehicles, and 826 chassis.

Of the passenger cars, 479 were from the United States, 268 from Great Britain, 172 from Germany, and 41 from Switzerland; of the commercial vehicles, 413 were from the United States, 142 from Germany 56 from Great Britain, and 3 from Switzerland; of the chassis, 731 were from the United States, 74 from Great Britain, 8 from Germany and 4 from Switzerland.

Thus more than two-thirds of all of the vehicles and chassis imported into France during the period mentioned were from the United States.

Tractor Exports Gain 84% In '37

Overseas Consignments of Wheel-Type Units Increase 93% With 15-32 Belt Hp. Class Claiming 61% of Total

Overseas consignments of tractors and parts in 1937 constituted 70 per cent of the total farm equipment exports, and were valued at $52,893,276, a gain of 84 per cent over the corresponding 1936 exports amounting to $28,758,697, or 65 per cent of the total, according to the Machinery Division, Department of Commerce.

Exports of wheel tractors last year aggregated $23,571,545, a 93 per cent increase over the $11,890,647 shipped abroad in 1936. Slightly more than 61 per cent of the wheel tractor sales during the year consisted of the 15-32 belt hp. sizes, the exports of which were more than double a year ago, or $14,434,053 against $6,482,907. Foreign purchases of the larger sizes of wheel tractors amounted to $7,862,936 compared with $4,753,550 in 1936 and accounted for most of the remaining business in these machines.

In the tracklaying type tractors, shipments abroad during 1937 totaled $12,618,324 in the fuel injection type and $8,049,462 in the carburetor type, 86 and 85 per cent increases, respectively, over the cor-

responding 1936 sales valued at $6,795,786 and $4,339,934. As usual, foreign purchases of the carburetor type were confined primarily to the sizes under 35 drawbar hp., of which $7,298,257 worth were purchased during 1937 compared with $3,690,540 in 1936.

In the fuel injection type, more than half of the export business was in the 35 to 59 drawbar hp. size range, $6,790,573 against $3,164,717 in 1936, and most of the remainder in the larger sizes, $4,718,863 compared with $2,684,974 in the preceding year.

Japan

(Continued from page 165)

perial Automobile Association, opposing the Manchuria Heavy Industry Development Co.'s proposed monopolization of the motorcar industry in Manchukuo.

Manchuria has been regarded as the most promising market for Japan-built cars, the statement says. Accordingly Y. Aikawa's attempt to control motor manufacture there through his recently established development concern is detrimental to the healthy development of the domestic automobile industry, the petition continues.

"What is more, the Manchurian firm attempts to employ foreign capital, on which the Manchukuo Government is said to guarantee a six per cent dividend per annum and tax exemption, a drastic difference from conditions in Japan."

However, the major manufacturers seem to realize that it will be difficult to obstruct this government-sanctioned project, for which Mr. Aikawa is going to seek American capital assistance on his trip to the U. S. shortly.

Toyota and Tokyo Jidosha are already diverting their efforts from Manchuria to North China.

New Jap Car Introduced

A new Japanese passenger car with a wheelbase of 120 in. and powered with a six-cylinder Nissan engine has been announced by the Kyoritsu Manufacturing Works, which is jointly managed by the Japanese dealers of the Chrysler line. The new model has been named "Nikko."

Substituting the Dodge model with similar features, the new model sells at around $1,600. The Kyoritsu also plans production of models to replace the 128-in. Dodge and the 113-in. Plymouth.

TOOLS OF TOMORROW

Grinding

. . . Cincinnati offers new line of machines in 12 in. and 16 in. sizes

A new line of universal grinding machines, built in 12 in. and 16 in. sizes; and 24 in., 36 in., 48 in., and 72 in. between-center lengths, has been brought out by Cincinnati Milling Machine and Cincinnati Grinders, Inc., Cincinnati, Ohio.

On these machines the spindle bearing design and its companion lubricating system compare with the arrangement on the Cincinnati roll and plain self-contained grinders. The bearings themselves are the multiple shoe type. No adjustment is necessary when changing from roughing to finishing operations, or vice versa, because the bearings are self compensating for changes in load.

The headstock unit has no gear contacts or worm drives. Power is transmitted from the motor to the face plate through the medium of V-belts and silent chain. A ¾ hp. variable speed motor, mounted on a vibration-absorbing shelf-type bracket, drives the unit. The unit may be swiveled through an angle of 150 deg. for face and angle grinding, and an infinite number of work speeds, ranging from 60 to 240 r.p.m., are available by adjusting the rheostat at the operator's working position in front of the bed.

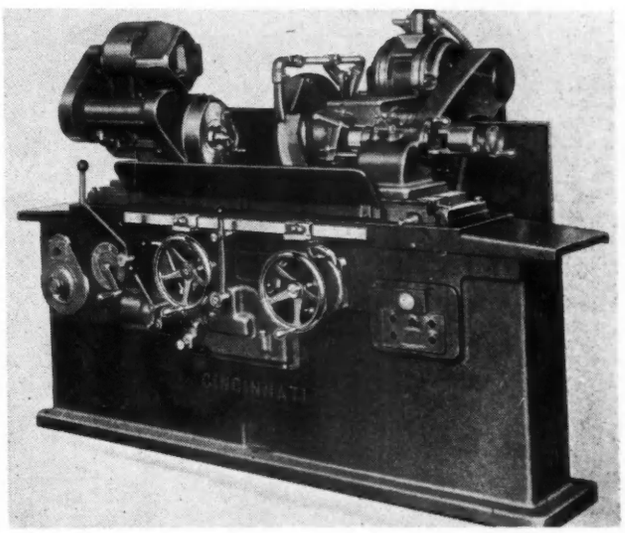
The wheel head unit provides accurate adjustment of the wheel to the work through square gibbed slides and narrow guides which are well protected from water and grit. This unit may be swiveled through an angle of 90 deg. either side of center.

Motion is transmitted to the table mechanically, by means of rack and pinion, and 12 traverse rates are available, ranging from 4 to 63 in. per min. A multiple disc clutch on the shaft of the table driving pinion eliminates the shock of reversal. Accurate alignment between the headstock and footstock units is obtained by means of a truncated locating "V" machined in the top of the table. Swivel adjustment of the table ranges from 10 deg. forward to 2 deg. back.

The footstock is provided with a combination screw and quick acting lever for moving the center in and out. A bracket for a truing tool is mounted on this unit. Incidentally, both the headstock and footstock have a No. 11 B&S taper hole in the spindle for the work center.

Work diameter reduction may be adjusted to an increment as low as 0.00025 in. through the automatic pick feed mechanism. A cross feed back lash arrangement is self adjusting.

The coolant pump is a ⅛ hp. motor driven unit, capable of delivering 15 gal. per min. Automatic starting and stopping of the coolant flow is available through the turn of a selector switch in front of the bed. Hand control may be employed, if desired.



Universal grinding machine offered in 12 in. and 16 in. sizes which was recently brought out by Cincinnati Milling Machine and Cincinnati Grinders, Inc., Cincinnati, Ohio

Automotive Metal Markets

Copper Price Cut by Custom Smelters and Mine Producers With Fabricators Also Making Downward Revision

Copper furnished the only exception to the otherwise humdrum state of affairs in the metal market this week. Following announcement by both mine producers and custom smelters that they had reduced their price to 10 cents, there was much speculation as to whether this move would have the desired effect of large scale covering by consumers. Sales on the first few days, following the price cut, were characterized as a keen disappointment.

Automotive consumption of copper last year is estimated at between 85,000 and 90,000 tons. The average price for the year was around 13¼ cents, but a good deal of copper was bought in March and April, when the price was between 15 and 16 cents. A difference of 3 cents a pound or $60 a ton means one of between $5,000,000 and $5,500,000 in the automobile industry's copper bill on the basis of last year's estimated consumption. There has been a good deal of adverse comment of late regarding the spread between the price named by custom smelters and that quoted by the large mine owners. Prices for fabricated copper and brass products were based on the higher metal quotations of the large mine producers, and consumers, who buy copper in fabricated form, failed to benefit from the price cuts by custom smelters. Immediately following announcement of the 10-cent price by all marketers, fabricators revised their prices downward.

There are those who fear that the influence of speculation in London will upset stabilization of the market here. Considerable bullish sentiment has developed abroad, due on the one hand to recurrent reports that Japan is about to buy heavily and on the other to the belief that the pendulum has swung too far in New York. When copper sold for one day, and one day only, at 10 cents in December, it was said that several large consumers were about to take on heavy tonnages. The custom smelters raised their price to 10½ cents on the following day and to this was ascribed the falling through of this business. These same consumers were apathetic when the market receded to 10 cents a few days ago. From April, 1931 to October, 1936, copper sold at below 10 cents; in fact, in the early months of 1933 at half that price.

Just as hopes of a buying wave developing in the 10-cent copper market led to disappointment, so 40-cent tin failed to arouse very much buying interest. There was a little covering at that price by consumers, but before long sellers, sensing the futility of bargain offers, advanced their price fractionally. Very little business was done at 40½ cents for spot Straits. On Tuesday the price was moved up to 41 cents.

Wall Street paid more attention to the recession in employed steel capacity, which this week is reported by the American Iron & Steel Institute as 30½ per cent, compared with 32.7 per cent last week, than did the steel market, where seesawing of production activities causes little surprise these days. In primary mills as well as in finishing divisions, the aim is to whittle down losses by shaping production schedules to the greatest advantage. This means that there must be a preliminary accumulation of orders and more or less intermittent operations until the turn for the better becomes more pronounced. With all the resulting ups and downs, the trend is bound to be obscure at times, but steel company sales managers, for the most part, say that incoming orders, light as they are, show that consumers are in need of steel and that this justifies a sane amount of optimism.—W.C.H.

Final Statistics on Gilmore-Yosemite Economy Run

As many readers of AUTOMOTIVE INDUSTRIES have expressed desire to examine the tabulation of final results of the annual "Gilmore-Yosemite Economy Run" for stock cars, we publish herewith these data as submitted by the Contest Board of the American Automobile Association.

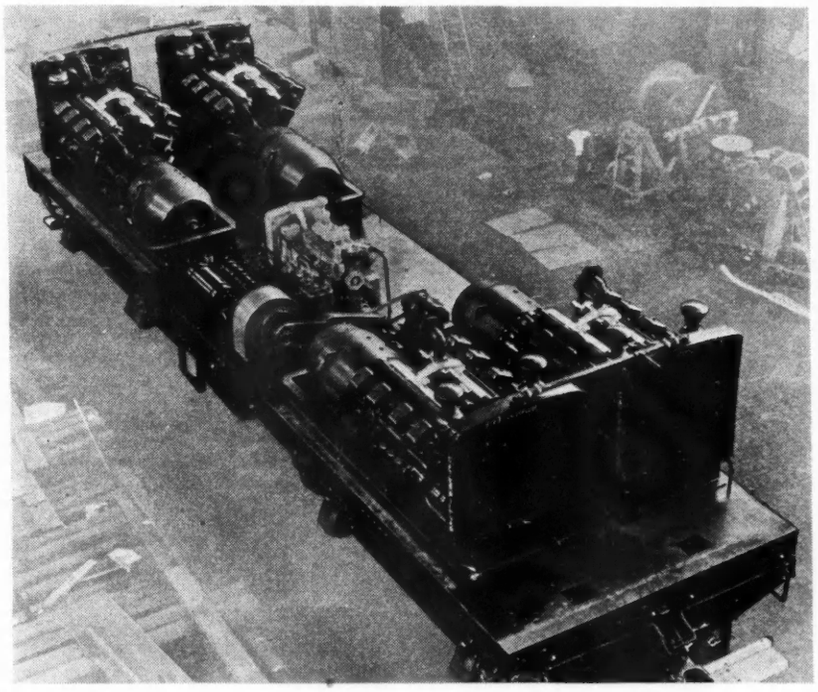
Cars entered in this economy run, held Jan. 13, 1938, were classified as follows: A. Four-cylinder cars; B. under $930; C. $931-$1,130; D. $1,131-$1,175; E. $1,176-$1,260; F. $1,261-$1,400; G. $1,401-$1,500; H. $1,501-$1,600; I. $1601-$1,960; J. over $2,000. These are Los Angeles, Calif., prices according to rail freight delivery for standard five-passenger, four-door sedan, with standard equipment. The run covers a distance of approximately 315 miles from Los Angeles to Yosemite National Park, Calif., via Bakersfield, Fresno, Friant, and Coarse Gold.

Class	Position	Make	Type	Weight (lb.)	Total Gas Used	Total Oil Used	Average Miles Per Hr.	Average Miles Per Gal.	Average Ton Miles Per Gal.
A	1	Willys 4	Sedan	3203	10.3	..	29.08	30.53	48.90
	2	Willys 4	Sedan	3210	10.7	..	29.08	29.39	47.18
	3	Willys 4	Sedan	3200	11.2	..	28.85	28.08	44.93
B	1	Ford "60"	Sedan	3519	10.9	½	28.94	28.85	50.77
	2	Chevrolet 6	Sedan	3955	14.3	..	29.17	21.99	43.49
	3	Plymouth 6	Trg. Sedan..	3808	14.8	¼	33.82	21.25	40.46
C	1	Hudson Terra.. 6	Sedan	3915	12.2	..	29.81	25.78	50.46
	2	Nash Lafayette. 6	Sedan	4379	14.1	..	33.64	22.31	48.84
	3	Pontiac 6	Sedan	4312	14.4	..	29.72	21.84	47.09
	4	Dodge 6	Sedan	3990	14.9	..	28.99	21.11	42.11
D	1	Pontiac 8	Sedan	4460	15.0	..	29.81	20.97	46.76
	2	De Soto 6	Trg. Sedan..	4144	15.2	..	32.31	20.69	42.87
E	1	Studebaker 6	Sedan	4250	12.9	..	30.93	24.38	51.81
	2	Oldsmobile 6	Trg. Sedan..	4338	16.4	..	30.19	19.18	41.60
F	1	Nash 6	Sedan	4530	13.3	..	30.68	23.65	53.56‡
	2	Graham 6	Trg. Sedan..	4279	12.7	..	30.44	24.76	52.98
	3	Hupmobile 6	Sedan	4402	14.4	..	31.98	21.84	48.07
	4	Packard 6	Trg. Sedan..	4458	15.5	..	29.48	20.29	45.23
	5	Oldsmobile 8	Trg. Coupe..	4545	16.5	..	30.00	19.06	43.32
G	1	Hudson 8	Trg. Sedan..	4336	13.8	..	29.12	22.79	49.41
	2	Nash 8	Sedan	4840	16.0	..	31.04	19.66	47.57
	3	Studebaker 8	Sedan	4540	15.2	..	32.26	20.69	46.97
H	1	Graham 6	Trg. Sedan..	4339	12.2	..	30.05	25.78	55.93*
	2	Hupmobile 8	Sedan	4794	15.3	..	30.73	20.58	49.27
I	1	Lincoln Zephyr 12	Sedan	4665	13.4	..	29.30	23.47	54.74†
J	1	Packard 8	Trg. Sedan..	5742	19.4	..	29.26	16.21	46.54

SWEEPSTAKES WINNERS

Position	Class	Make	Average Ton Miles Per Gal.
1*	H	Graham 6 (supercharged)	55.93
2†	I	Lincoln Zephyr 12	54.74
3‡	F	Nash 6 Sedan	53.56

NOTE Gasoline recorded in gallons, oil in pints.
The weight includes weight or car, four passengers, stock kit of tools, two sets of chains and baggage.



FOUR-IN-ONE A new 105-ton Diesel-electric locomotive powered by four "Caterpillar" V-8 Diesel engines and an auxiliary four-cylinder "Caterpillar" engine has been introduced by the Davenport Locomotive Works, Davenport, Iowa. The unit, pictured above, develops a total of 760 hp., with a maximum tractive effort in excess of 60,000 lb. Each of the four main engines is directly connected by flexible coupling to the four main generators. The auxiliary engine drives a 5 KW auxiliary generator which charges the battery, operates controls and lights. It also provides power for the compressor and blower for cooling the engines.

Main and auxiliary engines have Burgess mufflers, with the final exhaust carried out through stacks located above the engine hoods. These exhaust stacks also aid in ventilating the engine compartments. One throttle controls the speed of all four engines, DC generators and traction motors, thus regulating the speed of the locomotive with a single mechanical control in the operator's cab. Cooling systems of the two front engines are connected as are also the two rear engine cooling systems. Generator cooling is by means of a built-in fan. The fuel tank has 350 gal. capacity and is constructed of heavy steel plates arc welded together. It is said that the engine can operate four 10-hour days without being refueled.

Royal T. Hodgkins

Royal T. Hodgkins, 59, associated with the automobile industry since 1914, died Jan. 31. Mr. Hodgkins became sales manager of the Studebaker Corp. in 1914, and later was vice-president of the Cleveland Tractor Co., general sales manager of the Rickenbacker Co., and vice-president of the Federal Motor Truck Co. For a short period he served as general sales manager for the Durant Motors, Inc.

Mr. Hodgkins, at the time of his death, was connected with the U.S.L. Battery Corp.

Approve $500,000 Safety Program

Approving a budget of approximately $500,000 as the motor industry's contribution to 1938 highway safety, the operating committee of the Automotive Safety Foundation met in Detroit, Feb. 2, and reaffirmed its determination to continue the national program inaugurated two years ago.

Calendar of Coming Events

Foreign Shows

German Motor Show, Berlin, Feb. 18-March 6, 1938

Leipzig, Trade Fair, March 6 to 14, 1938

Conventions and Meetings

American Society for Testing Materials, Spring Regional Meeting, Rochester, N. Y. March 7, 1938

Machine and Tool Progress Show, Detroit.....March 9, 1938

SAE National Aeronautic Meeting, Washington, D. C. March 10-11, 1938

SAE National Passenger Car Meeting, Detroit, March 28-30, 1938

Chamber of Commerce Meeting, Washington .....May 2 to 5, 1938

American Foundrymen's Association, Foundry Show, Cleveland .....May 14-19, 1938

Books

of automotive interest

HANDBOOK OF CHEMISTRY AND PHYSICS, *twenty-second edition, Charles D. Hodgman, M.S., editor-in-chief. Published by the Chemical Rubber Publishing Co., Cleveland, Ohio.*

In this twenty-second edition of the well-known Handbook of Chemistry and Physics considerable new material has been added while old material has been revised.

Tables of gravimetric factors have been recomputed to conform to 1936 atomic weights, and some new tables have been added under this head. Data on the preparation of solutions and reagents have been completely revised and rearranged.

A new feature is a table on the transmission of gelatin filters. The table on radio tubes has been extended because of the increased number of thermionic tubes now available. Tables of weights and measures have been rearranged for greater convenience.

Other new data included in the new edition relate to viscosities, flame spectra, relative humidities from wet and dry bulb thermometers, index of refraction of fused quartz, the lowering of the vapor pressures of salts in acqueous solutions, meteorology, and the acceleration due to gravity and the length of the seconds pendulum.

Buick Reports 17% Sales Gain

A 17 per cent gain in deliveries of new Buicks together with a substantial increase in used car volume has been reported for the second 10 days of January by W. F. Hufstader, general sales manager, Buick Motor Division, General Motors Sales Corp.

Used car stocks declined during the period when volume rose to 8249 cars as compared with 6053 in the preceding 10 days, a gain of 36.3 per cent. At the same time, domestic deliveries of new cars totaled 3033, compared with 2587 in the first January period.

New Goodrich Industrial Tire

A new industrial tire for use where oily floors are encountered has been developed by the B. F. Goodrich Co., Akron.

The new tires are fabricated of especially compounded materials.

THIS IS THE TWENTY-SECOND IN THE SERIES OF MONTHLY PRODUCTION FEATURES

Quality Control

By JOSEPH GESCHELIN

DISTINGUISHED as one of the big names in piston rings, The Perfect Circle Co., with home headquarters at Hagerstown, Ind., holds no mean responsibility for the performance of 1938 passenger cars in this country. The final check of standard equipment business, made as this article was going to press, indicates that 37 of the 59 passenger car models for 1938—or 63 per cent—are 100 per cent equipped with P-C rings; while 40 of the 59 models—or 68 per cent—are 100 per cent or at least partially equipped with P-C rings.

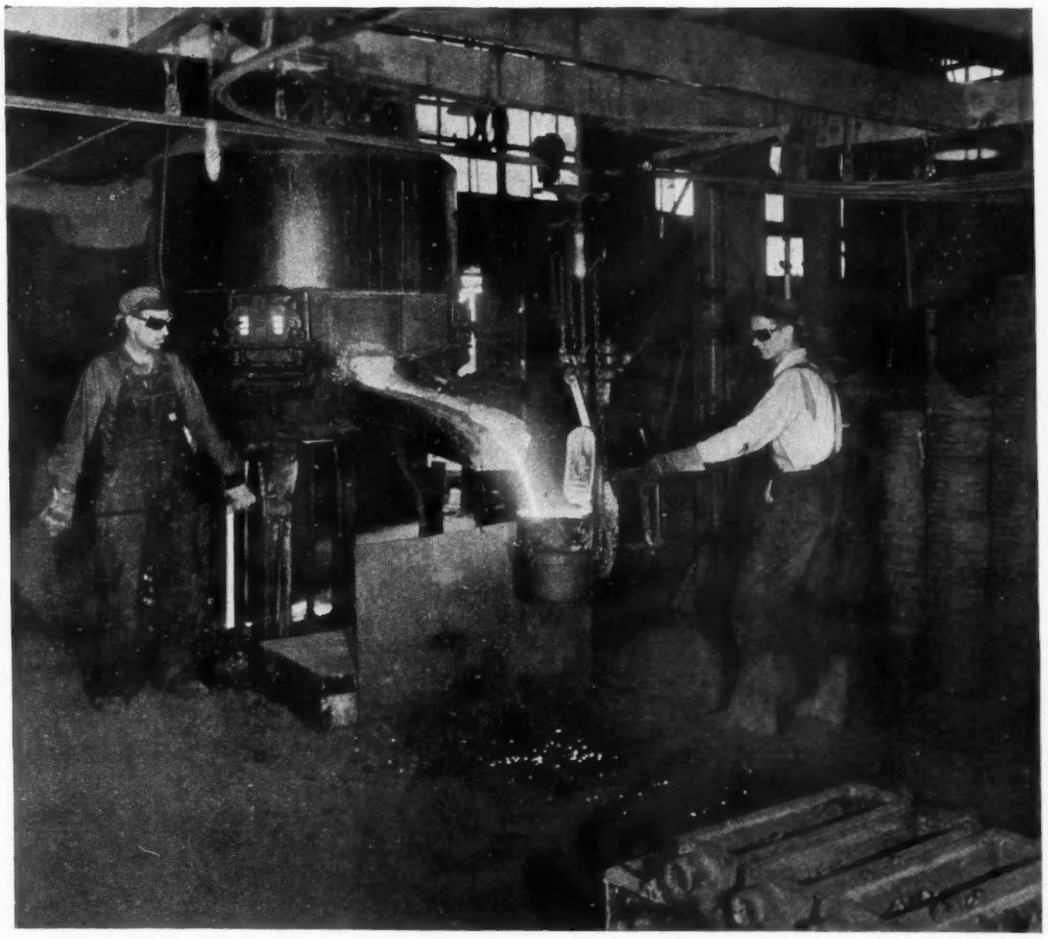
Like many other standard bearers of this great automotive industry, Perfect Circle owes its present position to the modest beginning born of the early stirrings of pioneer automobile builders. Forerunner of the piston ring business was the organization early in 1895 of the Railway Cycle Mfg. Co., in Hagerstown, by five Teetor brothers. Early in 1902 the name of the company was changed to The Light Inspection Car Company, and in 1914 again changed to the Teetor-Hartley Motor Corp. Reason for the last change was that the company had produced what was considered to be one of the best automobile motors built at the time, having been developed by the Teetor brothers over the early years of the automobile industry.

One of the handicaps facing the pioneer motor and motor car builders was the almost complete absence of a parts industry so that it was necessary for each producer to make everything he used. In building a good motor, the Teetor-Hartley organization had to develop and fabricate its own piston rings as well. Thus when in the spring of 1918, the motor business was sold to the Ansted interests of Connersville, the Hagerstown group retained the piston ring department—named it the Indiana Piston Ring Company—and continued the manufacture of rings for some of the largest motor car producers in the country, several of whom had been its customers while the parent company was producing motors.

From the very beginning of its piston ring department, the company had developed a method of producing individualy-cast rings, forerunner of the modern practice said to be almost universally used today. Many other early piston ring developments and refinements are attributed to the Perfect Circle Co., so renamed Oct. 15, 1926. Among the most important of these are the oil-regulating ring with the patented groove-and-slot principle, the type 70 compression ring, and the new X-90 oil and compression rings.

It is an interesting commentary

Finish turning operation. This operation gives the final finish on the face of the ring



Drawing iron from cupola into ladle preparatory to pouring ring castings

l at Perfect Circle

starts with analyses of all raw materials and extends to every operation in machining and finishing

that the second generation of the Teetor family widened the field of the piston ring business not only in point of volume as standard equipment and in the replacement field, but from the viewpoint of fundamental research in product design, materials, and engine development. The significance of this statement will be more obvious as our discussion develops further.

At the present time the Perfect Circle line includes a variety of products for original equipment as well as the replacement field, comprising the following items:

X-90 oil rings
X-90 compression rings
"70" compression rings
"200" compression rings
"85" oil rings
Piston expanders
Cylinder ridge cutters

In piston rings alone, the generic types noted above comprise a variety of over 7000 combinations of size and cross-section. Today the business has expanded to the point where in the interest of good service, the company carries a substantial stock of rings for equipment customers; and over 20,000,000 rings for its replacement trade. This stock is carried at Hagerstown and by jobbers all over the country.

Turning to the production facilities of this organization, we find that it operates four different establishments—the home plant in Hagerstown, a plant in Tipton, Ind., a plant in Toronto, Canada—all served by a comprehensive foundry in New Castle, Ind.

The Hagerstown plant normally employs about 700 people and has a productive floor space of 163,050 sq. ft. The New Castle foundry employs about 260 people and utilizes a floor space of 65,765 sq. ft. The Tipton plant employs about 125 people and operates with a floor space of 29,523 sq. ft. The Canadian plant in Toronto employs about 50 people.

Broadly speaking, the P-C organi-

First inspection. Inspecting grinding operations for dimension and surface imperfections

zation performs an invaluable service to the industry by virtue of progressiveness in thinking and in carrying on an unabated program of engineering research aimed not only at immediate problems but also at those of more fundamental nature. It may be readily appreciated by any one close to the automotive industry how the piston ring developments have anticipated refinements in engine design, and it is quite conceivable that the larger improvements in engine performance could not have been possible without this parallel development. So far as original equipment is concerned, probably two elements of recent origin have been almost sensational in their influence upon engine design. The first was the commercialization of the new well known "200" compression ring adopted by International Harvester and Buick, in the case of the latter offering the solution to the top ring problem on the new Turbulator piston which is a feature of the Buick Dynaflash engine for '38.

Coincidentally, P-C perfected what is known as the "Ferrox" surface treatment, a new development in ring metallurgy, said to achieve non-scuffing, quick-seating and long-wearing rings. This treatment, first made available on the "200" rings, making them resistant to scuffing, has been extended as standard practice in the surface treatment of practically all rings in the P-C line.

Tool room. Practically all Perfect Circle machinery is produced and maintained in this department

View of the order filling department

"Ferrox" treatment is the result of a process which changes the metallurgical structure of the ring by converting the raw cast iron surface into a black magnetic oxide. It is a process in which the surface grain structure is made extremely fine by accurate control, producing actually a mild polishing agent said to be finer than jeweler's rouge. Under conditions of metal-to-metal contact frequently encountered in the cylinder, these fine particles wear the ring to a perfect seat by polishing rings, piston and cylinder.

For the replacement trade, the company a few years ago placed on the market a line of piston expanders individually engineered for every model for which they were available —with specific recommendations for

Oil department. All rings are given an oil bath in order to prevent rusting

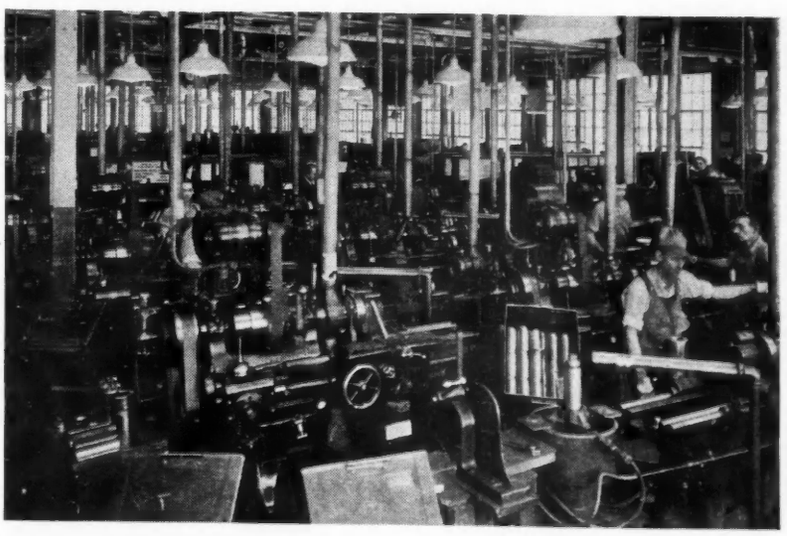
the facets of piston ring manufacture in this organization. It starts with a scientific control of raw materials and the ring castings so far as foundry operations go; it extends to close control of every operation in machining and the "Ferrox" treatment. Quality is assured, in the main, by a system of sampling inspection which is reliable and quite sensitive, supplemented by a series of 100 per cent visual inspection for surface perfection.

In approaching the details of the manufacturing operation, we are very much impressed with the fact that this article represents perhaps the first instance in the literature of a comprehensive study of piston ring manufacture. We offer it as tangible evidence of the cooperative aspect of the automotive manufacturing industry in all its ramifications, all working in the general community interest. It is not our intention to describe in detail the

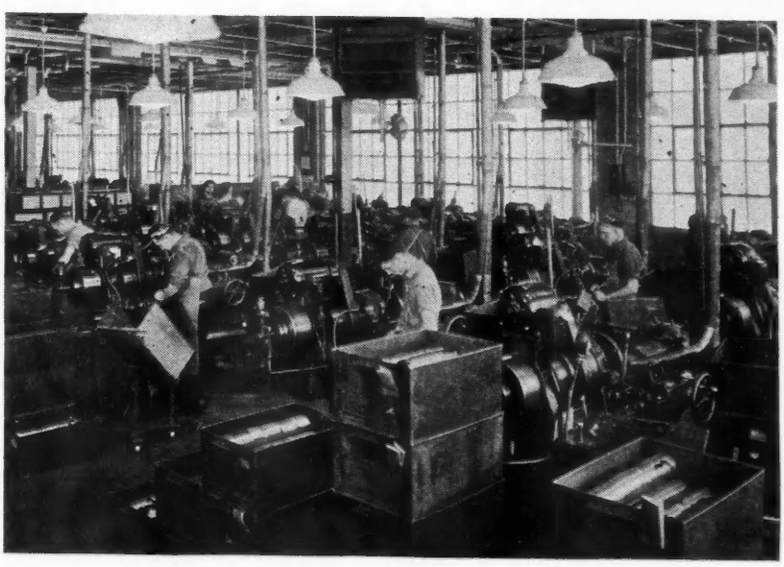
their economic use, developed through research.

Our trip through the P-C plants indicated that, even to the casual observer, quality control of every step in the manufacturing process in the foundry and in the machine shop is the priceless ingredient in piston rings. To the eye, all rings of the same size may look alike, but for an engine only those subjected to close control and guarded by the watchful eyes of skilled inspectors can be acceptable.

Quality control comprehends all



Inside boring operation. This lathe operation determines wall thickness



Grooving operation. This operation machines the grooves and slots for the various ring types

operations in the machine shop since all the equipment is of proprietary nature and quite unique to each piston ring producer. However, the pictorial section contains many views taken in the machine shop which

will acquaint the reader with high spots of the process.

As worked out by P-C over a period of many years, the process of piston ring machining has resolved itself into some 14 individual machine set-ups.

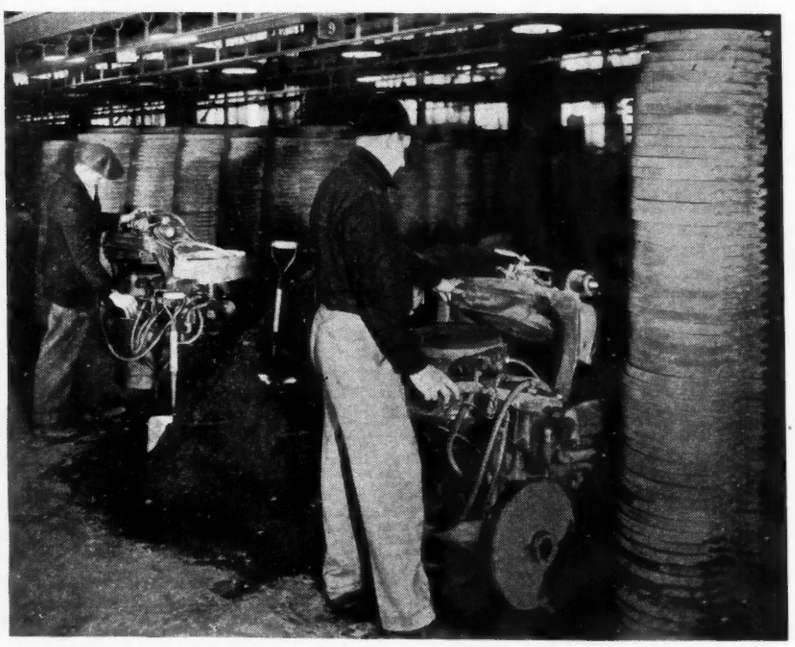
All of the machinery used for producing P-C rings either is specifically designed and built by the company or rebuilt and adapted from conventional machinery. To facilitate boring and turning operations on the variety of metals used here, the metal cutting machines are fitted with tools tipped with suitable grades of tungsten carbide. Each operation is closely controlled by process inspection at various stages. In the final inspection department, sampling is rather scientifically worked out by checking a definite percentage of each lot. If rejects approach a given percentage of the sample—a standard specification—the entire lot is then inspected 100 per cent. This is in accord with the best sampling procedures based on the modern statistical theory. All finished rings are given a 100 per cent visual inspection to assure freedom from surface imperfections. Skilled operators working at a fast but untiring pace unerringly find flaws that would pass unnoticed even in a searching examination by the untrained eye.

Machine shop operations have been greatly simplified in recent years by the expedient of rough-grinding the sides of rings before they leave the foundry. This is a rather simple operation in the foundry with the use of special purpose automatic grinders, but so far as the machine shop is concerned it releases productive space customarily required for the installation of a battery of disc grinders together with inspection benches.

Final disk grinding operation. This operation removes additional stock from the ring sides

Another virtue in having the preparatory grinding done at the foundry is that the operation frequently exposes surface defects chargeable to the foundry crew. Thus this operation serves not only as a check on foundry quality but it confines spoilage or salvage to the source.

Following the final stages of inspection, the rings are sent to the packing department where they are sorted, oiled and packaged. The packaged rings then are warehoused in the stores department where shipments are made up for the various customers whether they be motor builders or automotive jobbers.



Molding machine in the foundry. This machine makes the sand mold for the ring casting

Foundry

The foundry at New Castle is a self-contained plant combining complete foundry facilities with tool room, pattern shop, metallurgical laboratories, machine shop and quality control. Molding is done on two floors, each one being equipped with cupolas and pouring lines.

Due to the great variety of ring sections and sizes, the foundry produces special iron analysis for rings of different types. To this end, the bulk of the large production rings are molded and poured on the second floor, served by two cupolas. Large diameter rings and all special alloy rings are molded and poured on the first floor which is served by a conventional cupola and a Detroit Electric Rocking furnace.

Iron is poured at a temperature of approximately 2800 deg. Fahr., which is somewhat higher than is customary for ordinary gray iron. The molten metal is carried by monorail in 120 lb. ladles to the molding

floor. Not only is the temperature accurately controlled but the charge in each cupola is sampled at regular intervals during the day and carefully tested in the metallurgical laboratory.

Individual patterns are used on a plate from which each mold is made, the molds form stacks eighteen or more high for pouring purposes. Automatic molding machines built and designed by the company are used throughout. Flexibility is achieved on the molding floor by using a standard machine base to which all patterns are adapted. Thus it is possible to swing over from one size of ring to another, on the same molding machine, without affecting its operation and with but small loss of time in setting up.

Sizing operation. This operation machines the ring to its correct diameter

Final inspection. This is a 100 per cent visual inspection operation before packaging

the day, are completely machined in accordance with the procedure in the machine shops at Hagerstown, Tipton or Toronto; then subjected to various mechanical tests for hardness, elasticity, strength, etc. This gives a remarkably accurate picture of the conformity of the product to established specifications and provides the best possible assurance that all foundry mixtures and techniques are up to standard.

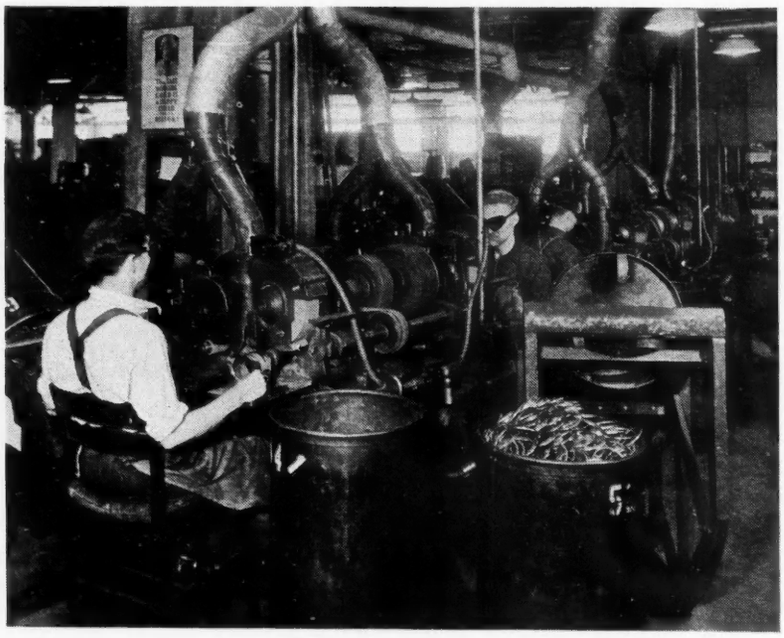
We touched briefly upon the laboratory resources of the foundry. It may be well to expand on this statement at least to the extent of noting some of the activity. In the first place, there is a separate laboratory with a technician engaged in constant routine checking of sand. An-

Stacks of molds on the molding floor are built up in long rows parallel with the overhead monorail so as to permit pouring from the ladles with a minimum amount of handling and in the shortest possible time.

As the final operations in the foundry, all castings are rattled and then disc-ground before shipping to the machine shops. As mentioned earlier, the latter operation also serves as a test of surface quality and is used as the basis for paying the molders who are on an individual bonus plan in which they earn a bonus whenever their rejections fall below a definite percentage.

One of the most fascinating activities in the foundry is the operation of an experimental production machine shop in which sample lots of each batch of rings produced during

This view shows the counter bore operation



Snag grind operation. This operation removes the inside and outside scale from the casting

other department is concerned with chemical analysis of metals. Then there is a separate crew for metallurgical research and mechanical testing of all types.

The metallurgical department is provided with the most modern equipment including facilities for metallographic investigation. It is set up not only for routine testing but for fundamental research as well.

Research Laboratories

Without research there can be no technical progress and at P-C research is not only a major activity but one that is pursued unflaggingly. Thinking in terms of piston rings and cylinders, they look for two unique elements of engine performance—oil consumption and blow-by. These are unfailing indexes of piston ring performance as they reflect, in addition, the life and wearing characteristics of the elements within the cylinder.

The laboratories are equipped with six standard electric, two hydraulic and one chassis dynamometers for routine testing of engines. In all cases, the test machines are fitted with meters for checking blow-by.

Supplementing the conventional test equipment, the research department has developed special single-cylinder engines with an extremely generous sized crankcase, and large crankshaft and bearings so as to confine engine operation variables to the cylinder. The cylinders are built with L-head and valve-in-head, heads so as to permit the study of both types. All these engines are connected to standard electric dynamometers.

Finish grind operation. This operation gives the final dimension and finish to the ring sides

Intermediate disk grinding operation. This operation removes stock from sides preparatory to finish grinding

Here, too, was developed the special wear testing equipment which was used in studying the "Ferrox" process. This machine is an adaptation of their single cylinder engine, using the same crankcase, turned on its side, with a cross-head mechanism communicating with an external slide in which the test specimens are mounted.

Community Interest

Quite apart from its technical contributions to the motor industry, P-C is distinctive in the possession of a priceless business stability born of its unique environment. This fact is emphasized here because of its unquestioned bearing upon the

ability of the company to serve its customers.

Ever since the Teetor industrial dynasty was founded in 1895 by the Teetor brothers it has remained the first and only industrial enterprise in Hagerstown and its environs. Hagerstown proper has a population of only some 1400 people, and in consequence the plant draws upon the working population of the surrounding area within a radius of about 15 miles.

There is a feeling of security and contentment in the community quite foreign to the complex undercurrent of social activity in larger industrial communities. The people hereabouts are a loyal group actively interested in the well-being of a home industry and anxious to promote and continue the friendly relationship between the management and workers. Fortunately for the business as well as the loyal community it serves, the management has been far-seeing in its efforts at stabilizing the flow of business and employment; 93 per cent had full time employment in 1937, one of the highest employment records in the industry. While a good share of the production is its standard equipment business, the usual peaks and valleys of production have been smoothed out by an ever expanding replacement trade fostered through jobbers, wholesalers and dealers.

View of the foundry machine shop

Form turn operation. This lathe operation gives Perfect Circle their correct shape

Thus the loyal workers of this unique community are spared to a great extent the impacts of the ordinary course of employment in the larger industrial centers and the yearly income per person is probably well above the average in mechanical trades.

In sum total, Perfect Circle possesses business attributes that may well be envied by its contemporaries and appreciated by its customers.

British Industry Firm at High Level

IN an "economic retrospect" of 1937, *Engineering* says that the British engineering industry (machinery industry), which expanded very rapidly throughout 1936, tended during 1937 to settle down at the high level of activity attained during the fourth quarter of 1936. Comparing the first three quarters of 1937 with the corresponding period of 1936, there was an increase in activity of approximately 12.5 per cent. The Board of Trade Index of Production suggests that the period of rapid expansion may be coming to an end.

British exports of machinery increased by about 14 per cent in 1937, to the highest figure since 1930, but remained nearly 23 per cent below the 1929 level. Satisfaction is expressed with this increase in exports, as the view has been expressed repeatedly that the rearmament demand at home would reduce temporarily the capacity to export of the British engineering industry. Production capacity increased approximately 35 per cent between 1929 and 1937, and exports in 1937 were 50 per cent to 60 per cent below what they would have been if the 1929 ratio of production to exports had been maintained. The decrease in the exports of machinery since 1929 has been almost entirely in exports to foreign countries, the exports to the British Empire having been only slightly less in 1936 than in 1929.

Retained imports of machinery, that is total imports minus re-exports, showed a further considerable advance in 1937 and stood at the highest total recorded during the past decade. There is little doubt that the principal reason for this increase was the need for quick delivery of machine tools and other equipment in the production of which the British industry was already working to capacity.

Just Among Ourselves

Used But Not Forgotten

AT the flood tide of panaceas for the used-car problem, a faction of the Pennsylvania dealer body will gather in Harrisburg next week in an attempt to remove the legal tangles which have prevented the application of Pennsylvania's fair-trade practice law on used-car trade-ins.

It is difficult to tell whether Pennsylvania dealers are worse off than other large segments of the dealer body with respect to the magnitude and sluggishness of used-car stocks.

Whatever may be the case, setting up a state authority for the control of trade-in allowances will never, never expedite the sale of used-cars from swollen stocks. And it won't prevent the stocks from accumulating.

Theoretically, cars traded under such a code would be taken in at a price which would allow profitable re-sale. But profitable re-sale of used cars almost always implies rapid turnover, and anything which tends to stagnate the turnover rate is an enemy to profit.

It is a dangerous doctrine from the standpoint of any private enterprise, to get it established on the statute books as being "in the public interest" like a public utility or the milk supply. Such a doctrine leads inevitably to the control of maximum profits, and the control of maximum profits has led, paradoxically, to a diminution of minimum profits for the industries concerned. Today's newspapers carried a statement that most American railroads lost money last year, but that sales of toy trains were profitable. Too much regulation might take the profit out of real automobiles.—H.H.

Air Compressor Powered By Free-Piston Engine

At a recent meeting of the French Society of Automobile Engineers the Marquis R. P. Pescara presented a paper dealing with his free-piston type of internal-combustion engine and air compressor which is being built in France as a portable compressor unit for construction work but has been applied also to a locomotive. In his development the inventor was assisted by the Bréguet firm and by the Société Alsacienne de Constructions Mécaniques, and the locomotive referred to was an old switching locomotive supplied by the French State Railway and was equipped with one of these compressor units, which furnishes compressed air instead of steam to the engine of the locomotive.

The Pescara engine-compressor consists of a power cylinder in which there are two power pistons which by their reciprocating motion draw in and compress air. The machine works on the two-stroke Diesel cycle, fuel being injected into the charge of air compressed between the two pistons at the end of every compression stroke. Each of the power pistons connects through a piston rod with a compressor piston in a compressor cylinder, all three cylinders being in line with each other and formed in a single casting. The piston rods pass through the cylinder heads and between the power pistons and their cylinder heads are formed cushion chambers which cushion the pistons as they approach the ends of their strokes.

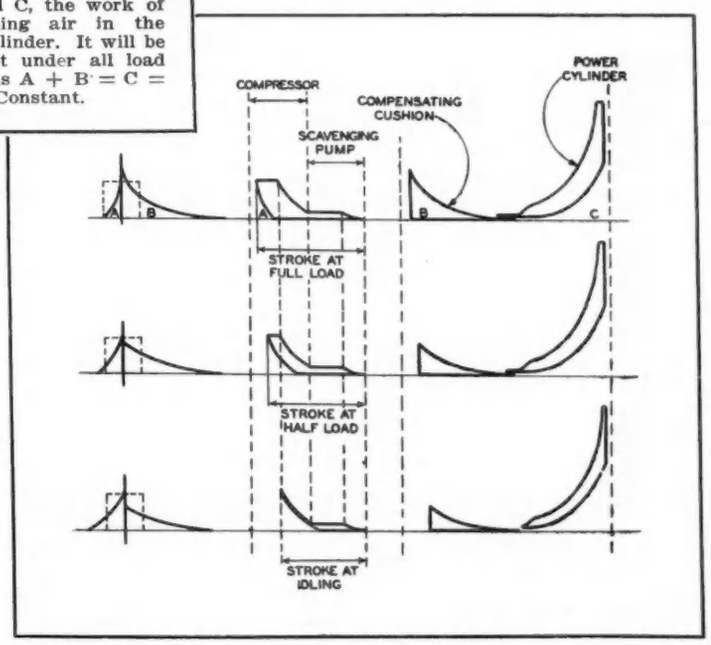
Scavenging is effected by means of some of the air delivered by the compressor cylinders. It will be seen that there is a series of ports in the wall of the compressor cylinder at about mid-length, and during the first part of the compression stroke in the compressor cylinder, air is forced through these ports into a scavenging-air housing. As soon as one of the power pistons uncovers its inlet port, scavenging air rushes into the power cylinder and scavenges it.

As the compression stroke continues, the air is compressed further in the compressor cylinder, and when the pressure exceeds that in the air tank, the delivery valves open and air is delivered to the tank.

In the design of a unit of this type, a certain number of novel problems arise, and the author explained the solutions of these problems worked out by him. In the first place, the two dual pistons must not only move outward (away from each other), but they must also be returned. As the engine works on the Diesel principle, that is, with compression ignition, it is essential that the pistons always be returned to their inward position with sufficient force to produce the compression and the temperature necessary for ignition of the fuel. A compression of approximately 500 lb. per sq. in. is necessary, and the pistons, therefore, always must be returned to points which will give this compression.

The outward motion of the pistons is caused by the combustion of fuel in the space between them, and the length of stroke will depend upon the amount of fuel injected. The energy of the combustion is converted into kinetic energy of the pistons in the first place, and then into the pneumatic energy of compressed air. From this it may be concluded that the energy of the air trapped in the clearance space of the compressor cylinder varies greatly, for the pressure in the clearance space at the end of the compression stroke is always equal to reservoir pressure and the volume of the clearance space decreases as the stroke increases. A machine depending on the compressed air in the clearance volume of the compressor for the return of the pistons would be unstable, as the firing of the charge would be uncertain.

To solve this problem, Pescara provided an independent cushioning chamber on each piston rod. The arrangement shown in the illustration is very satisfactory from the standpoint of compactness, but it left something to be desired from the point of view of piston cooling, and in the latest design these independent cushioning chambers are placed outside the engine proper. The energy of the air compressed in these cushion chambers varies inversely as



Cylinder diagrams of free-piston engine-compressor unit.
In the diagrams the area A represents the work of expansion in the clearance spaces of the compressor cylinders; B, the work of expansion in the compensating cushion chambers, and C, the work of compressing air in the power cylinder. It will be seen that under all load conditions A + B = C = Constant.

the energy stored in the clearance space of the air compressor, because the pressure in the clearance space is always equal to tank pressure and the volume of the clearance space increases as the stroke decreases. The sum of the energies in the clearance space and the cushion chambers is substantially constant, which assures the proper return of the pistons under all operating conditions. This conclusion has been confirmed by practice, for with a free-piston engine of 6.69-in. maximum stroke the position of the piston at the end of the return stroke was found to vary by less than 0.040 in. between idling and full load.

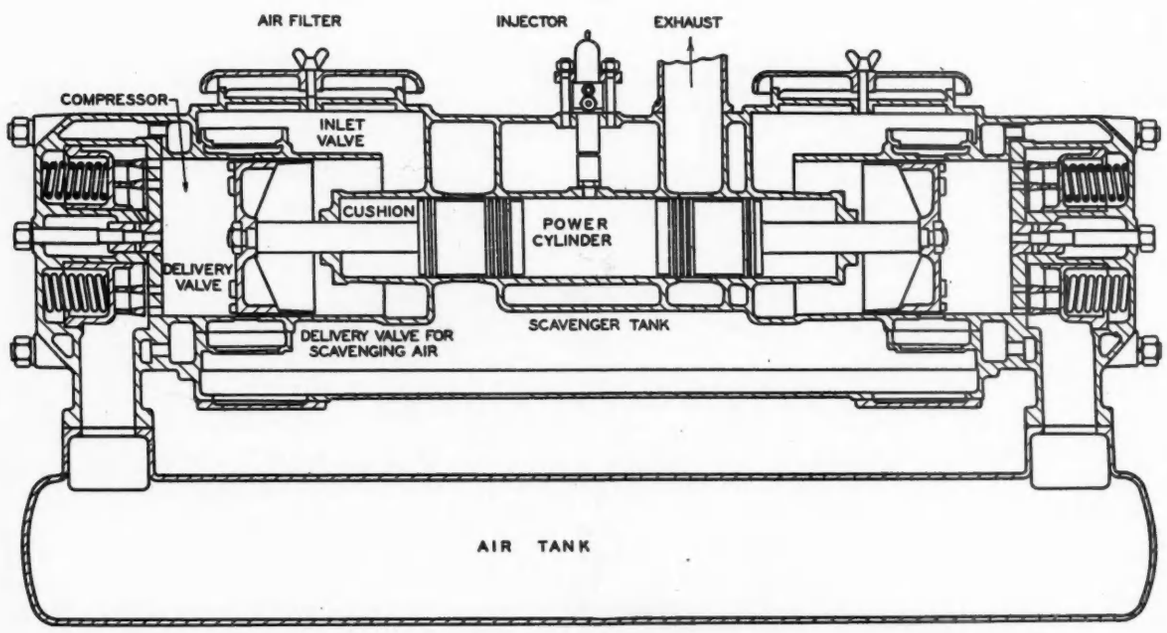
In this machine, as the output varies the stroke varies. If the stroke is not sufficiently long to compress the air in the compressor cylinder to the pressure of the tank, then the delivery valve does not open and the machine idles. By increasing the amount of fuel injected per cycle, the stroke is increased, and so is the air delivery per cycle.

It is not only desirable that the pistons should always reach a certain point on the return stroke (to produce the compression necessary for ignition) but also that they should not pass a certain point on the outstroke. The opposed pistons are connected to each other by rocking levers and pairs of links or connecting rods, whose function it is to assure symmetrical motion of the two pistons. This crank mechanism merely serves to compensate for slight differences in the friction encountered by the two pistons and does not transmit the power as in a conventional engine. The crank mechanism also serves as a safety device. Provisions must be made so that the pistons cannot hit the end of the cylinder. In normal operation this cannot occur, as the pressure rise in the independent cushion chamber prevents it. In practice the cranks have an oscillating motion, describing an angle of about 120 deg. between extreme positions. It is nevertheless true that by some mischance a very strong explosion might throw the pistons too far. In that case the crank mechanism passes through dead center and thus returns the pistons. The cam of the injection pump is then 180 deg. out of phase, so that no injection takes place and the engine stops.

Another problem which had to be solved was that of starting. At the start there is no air pressure in the tank or reservoir, consequently no energy is stored up in the clearance space for the return of the pistons. This problem was solved by comparatively simple method of acting on the delivery valve. Behind these valves there is a cross bar on which act the springs that hold the valves to their seats. The result of this is that as long as the reservoir pressure is below normal, the valves do not leave their seats. During the start the pressure in the cylinders may rise to as high as 180-200 lbs. per sq. in., or twice as high as in regular operation. The reason for carrying the pressure so high during the starting period is that during this period the compression in the power cylinder is far from being adiabatic, and if it were not for this extra store of energy, which is used to compress the air in the power cylinder, compression would not be high enough and the engine would miss. If a misfire occurs in a free-piston engine the starting operation fails, as there is no flywheel. Compressions of 750, 900 and even 1000 lbs. per sq. in. are therefore used for starting, so that there is positive firing even if the engine is cold. After a short period of operation at these high pressures the change to normal operation occurs automatically.

During the period of transition from a cold start to normal operation, while the pressure in the tank is rising gradually, air is admitted to the latter through a small, calibrated opening, fitted with a valve that is held to its seat by a spring. When the tank pressure attains a predetermined value, that pressure withdraws the cross bar which holds the main delivery valve to its seat, and the machine then begins to operate in the normal way. By changing the opening or orifice through which air enters the reservoir during the starting period, the time allowed for warming up can be varied.

(Turn to page 184, please)



Sectional view showing principle of operation of the Pescara free-piston engine

A Testing Machine

for bearing metals has been developed by the German Experimental Institute for Aeronautics to simulate operating conditions in an internal combustion engine

A BEARING-METAL testing machine designed to simulate the conditions under which the bearings of internal-combustion engines operate has been developed by the German Experimental Institute for Aeronautics and was described in an article in *Automobiletechnische Zeitschrift* by Dr. Heinz O. Heyer. In describing the principle on which the machine operates, Doctor Heyer takes the case of an intermediate bearing of a two-stroke engine with crank units on opposite sides of it displaced by 60 deg. The conventional polar diagram for such a bearing shows that the load varies both in magnitude and direction, but that it is directed upwardly for two short periods of the cycle only. It was felt that in order to obtain an accurate index of the quality of a bearing metal tested, it would be necessary to use in the testing machine, bearing proportions, rubbing velocities, temperatures, and lubricants corresponding closely to the values obtaining in practice.

A side elevation of the testing machine is shown in Fig. 1. The load on the bearing under test is due to centrifugal force on a revolving eccentric mass on shaft G, which is applied through the connecting rod P and a toggle mechanism comprising the links A-B and B-C. The test bearing L is carried on a straddle-mounted stationary journal Z and is rotated through spur gearing from the drive shaft W. From this same shaft is driven the eccentric on shaft G. Surrounding the test bearing L is a roller bearing which forms the lower pivot of the toggle mechanism. The upper end A of the toggle is so guided by a member H that its motion, which has an amplitude of 0.040 in., is practically vertical. Pressure element M, which is slidable in F, is pressed upward by springs against a spindle, which latter can be adjusted vertically by means of the handwheel.

During each revolution of the eccentric mass passes through dead center twice, and as the motion of the toggle is opposed by the elastic resistance of the frame of the machine (combined with that of the pressure element), the load on the bearing passes through its maximum value twice during each revolution of the eccentric. For this reason the eccentric is geared to turn at one-half of the speed of the driving shaft W (and of the test bearing), so that the load on the bearing may pass through one cycle during each revolution.

As the upper end A of the toggle rises, the load on the bearing at first increases gradually, owing to the taking up of the play between a number of moving parts. The throw of the eccentric is adjustable between the limits of 0.8 and 1.12 in. By adjustment of the pressure element by means of the handwheel, three different types of load curve for the test bearing can be obtained, as shown in the inset at the upper left-hand corner of Fig. 2. In the first the bearing is without load during part of the revolution; in the second the load varies from zero to maximum and back again, and in the third the load never drops to zero but fluctuates between positive maximum and minimum values.

The test bearing is a one-piece bushing without oil grooves, of about 2.4 in. diameter and of a length varying between 1.2 and 1.6 in. Oil is supplied at the unloaded side of the bearing through an oil hole in the supporting journal. At speeds of 1600-1900 r.p.m. the rubbing velocity amounts to 1000-1200 ft. per min.

The member referred to in the foregoing as the presssure element is a piezo-electric unit which when

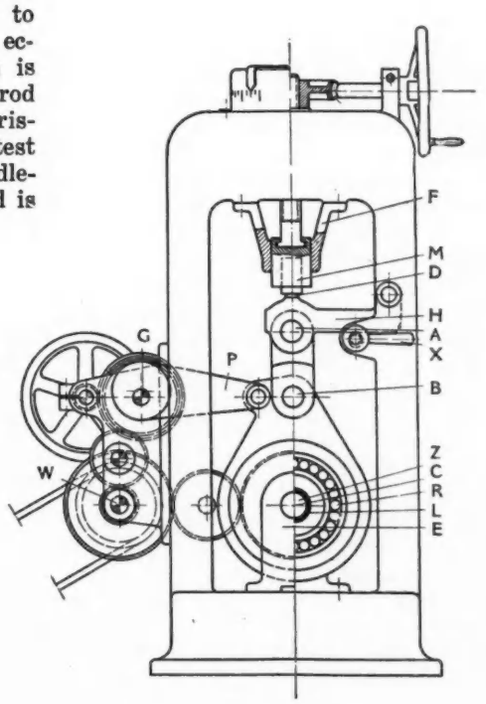


Fig. 1 (at right)—Front elevation of D.V.L. bearing-metal testing machine
A-B, upper toggle link; B-C, lower toggle link; R, roller bearing; L, bearing under test; Z, bearing journal; E, front bearing pedestal; H, guide; D, pressure block; M, pressure element of indicator; F, guide for pressure element; C, eccentric shaft; P, connecting rod; W, drive shaft; X, control lever for guide H.

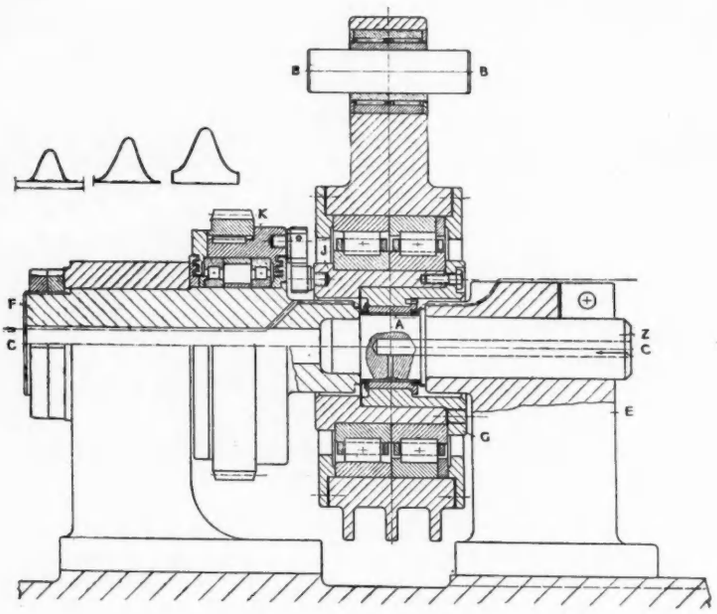


Fig. 2 (Above)—Longitudinal section through testing machine, showing arrangement of the rotating test bearing

A, bearing under test; E and F, front and rear pedestals for the journal on which the test bearing revolves; J, driving sleeve; K, driving gear; Z, journal; B-B, axis of the middle joint of the toggle mechanism; C-C, axis of the bearing under test and of the lower pivot of the toggle.

connected electrically to an oscillograph (the type actually used is a cathode-ray tube) gives a record of the cyclic variations of the load on the bearing.

No friction-coefficient determinations are made with this machine, as the friction of a bearing under normal operating conditions does not vary much with the bearing metal, and the friction coefficient, therefore, is not an important factor in the behavior of a bearing. In a test, the bearing is subjected to maximum momentary loads of between 1420 and 3550 lb. per sq. in., and the changes in the bearing surface which result from continued running under these loads are taken as indices of the quality of the bearing metal. In hard service, bearings usually develop cracks and scores as a result of the changes in magnitude and direction of the load.

In test runs extending up to 22 million revolutions, it has been shown that changes in the bearing surface during the running-in period tell the story of the character of the bearing material. The first thing that happens is that polished areas appear at high spots in the bearing surface, which latter are due to unavoidable deformations of the bushing. These high spots carry the entire load of the bearing, and the bearing material of these sections therefore is overloaded. With white metal under normal operating conditions, these polished spots usually disappear in a few hours, owing to the low resistance to deformation of the material, whereas with lead bronze it requires from 30 to 40 hours for the spots to disappear. Following this period, bearing metals of insufficient endurance show the characteristic bearing defects more or less plainly. Bearing materials that are satisfactory in service develop during this running-in period a surface that is capable of withstanding the repetitive loading indefinitely.

With all of the bearing materials so far tested, it was found that the first three to five million revolutions determined whether or not the material was suitable for use in engines. Of course, further changes take place in the surface, but these have no injurious effects, as the general character of the bearing surface remains unchanged. Unsuitable bearing materials do not attain this state of stability. With none of the bearing materials that showed up well in the testing machine and which proved their value in service, did any defects develop after 10 million revolutions, and this figure therefore was adopted as the criterion of suitability of bearing metals for use in engine bearings by the Experimental Institute.

Air Compressor Powered by Free-Piston Engine

(Continued from page 182)

Output control of a free-piston engine is a very simple matter, as all that is necessary is to vary the quantity of fuel injected per cycle. This control is effected automatically by means of a pressure cartridge opposed by a spring. When the pressure in the reservoir decreases, the pressure cartridge moves the fuel-control lever in such a direction as to increase the quantity injected, and vice versa.

In the smaller units starting is effected by means of a spring. It is also possible to start by means of compressed air, but this system is more complicated and therefore better adapted to large units.

The author stated that a hundred of these units had been built. The locomotive which was converted by means of one of these units was an old switching locomotive and the unit installed had a capacity of 200 hp. The power pistons of this unit have a diameter of 14 in. and the compressor cylinders of 18 in. The air is compressed in two stages.

Another difficulty that arose was in connection with the injection. As there is no crankshaft and no flywheel, there are no moving parts when the pistons are in the dead center position, and it was therefore difficult to apply ordinary injection pumps. This made it necessary to develop a cumulator-type pump.—*Journal of the (French) Society of Automobile Engineers* for July, August and September.

The vulnerability of rubber to mineral oil is being overcome in various ways. Among the methods employed is the adjustment of the compounding ingredients to reduce their tendency to swell when in contact with oil, the addition of materials impervious to oil, such as glue, gelatine, etc., and the adoption of different sulfur compounds for vulcanizing, such as Thiuram sulfides which have given the best results so far. Inflammability is overcome by incorporating in the material a new type of synthetic wax.

Fuels — Manufacturing — Noise*

Progress in Automotive Manufacturing

"An Appraisal of Current Progress in Automotive Manufacturing" was the title of a paper by Joseph Geschelin, Detroit technical editor of AUTOMOTIVE INDUSTRIES. Mr. Geschelin pointed out that of the various machining processes in use today, the newest is that of surface broaching which had its beginning—in mass production at least—when, only a few years ago, it was adopted by Plymouth for broaching the engine main-bearing joint surfaces. Since that time it has been applied widely, in other plants and to other operations.

Climb milling, a process which has been known for a long time but has seen little use in the past, is now in the ascendency. Under the designation of "turn-milling" it has been developed by DeVlieg and was shown for the first time at the Machine-Tool Show of 1935. Spicer has done well with it on a particularly difficult metal-cutting job and is now experimenting with an application of the same principle to the cutting of splines and gear teeth.

Single-point boring of engine cylinders, using massive boring spindles with fly cutters tipped with cemented carbide, was pioneered by Ford in tooling up for the production of the Ford V-8 85-hp. block. Later this practice was extended to the boring of the 60-hp. V-8 and the Lincoln Zephyr V-12. Almost at the same time Cadillac adopted the Heald horizontal precision boring machine for boring the V-8 blocks of the LaSalle and Cadillac. Since then the method has spread. Buick is now using it and last season Minneapolis-Moline installed the Heald machine for boring a variety of tractor and industrial engine blocks.

The demand for "quiet" transmissions has created a revolution in gear-cutting procedure. Informed circles recognize that quality gearing of the kind demanded today depends upon a chain of interdependent conditions — starting with the basic material of correct analysis, grain structure and control; proceeding through properly controlled drop-forging practice; gear cutting, heat treatment, etc.

Welding has become one of the major production processes. It is largely applied in the production of all-steel bodies, and in its various forms—torch welding, arc welding, resistance welding—it plays a part in the production of many automotive parts and structures.

Cemented carbide tools, whose commercial introduction dates back barely ten years, play a vital role in modern metal-cutting processes. How the advent of this new metal-cutting material revolutionized machine-tool design is a story all by itself. This material is now available in a number of grades, suitable for many kinds of material to be cut and to many metal-cutting operations. Probably the next step in the development of its field will be its economic extension to job-lot work, where frequent changes in set-up have not justified special tools heretofore.

Grinding has grown by leaps and bounds, culminating in automatic sizing and gaging and the automatic cam grinder. At Minneapolis-Moline, a conventional cylindrical grinder is being used to rough-grind crankpins, dispensing with the pin lathe.

Many important changes have come in metal stretching and the design of presses. The turret top, pioneered by Fisher, heralded the use of the huge three-story-high presses to handle these tremendous stampings. With all-welded construction characteristic of Hamilton, Clearing, and others, grace and beauty have entered the atmosphere of the big press shop. Built-in automatic lubrication systems safeguard these giants and assure trouble-free operation, so far as lubrication is concerned.

Synthetic enamel finish for lower- and medium-priced cars is revolutionizing body-finishing practice. Its commercial use was inaugurated by Ford several years ago. This season synthetic finish was adopted by one of the independent motor car manufacturers for its whole line. During the recent car-announcement season it was reported that Lincoln-Zephyr had obtained a particularly handsome synthetic finish by the use of a special 500-grit paper that removes the "orange-peel" effect and achieves a brilliant and lasting luster.

Evidently the stage is set for a wider use of synthetic materials which have been with us as research products for so many years. The only bar to their general adoption is the need for additional equipment in the form of baking ovens, implying also the need for additional space for such equipment in body manufacturing plants.

An Anti-knock Fluid and De-icer

THE use of a preparation known as Anilol as an anti-knock fluid and de-icer for airplanes was dealt with in a paper by L. B. Kimball of the Fuel Development Corp. It is a mixture of aniline and various alcohols with corrosion inhibitors. The preparation is injected into the carburetor air scoop and a valve was developed which delivers the proper amount of the anti-detonant under all operating conditions. There are two levers on the valve, the long lever being connected to the throttle and the short one to the mixture control. The opening of the valve is accomplished by a cam mechanism which is operated by a change in the relative positions of the two levers. Thus, as the throttle is opened, the mixture control holds the short lever stationary, and movement of the long lever engages the cam and opens the valve at some predetermined manifold pressure. The amount of flow can be regulated by moving a taper pin (on the other end of the valve in an orifice. With this arrangement the metering of quantities as low as 50 cc/min. can be accomplished with ease. The Anilol is fed through the valve by gravity and the flow can be checked at

* Papers presented at SAE annual meeting in Detroit.

known points on the throttle by holding a graduate under the Anilol outlet tube and taking the quantity which comes through in a given time. The short lever, which is connected to the mixture control, moves the cam engagement point ahead as the mixture is leaned out at altitude. This keeps the valve from opening as the throttle is moved to compensate for altitude.

In the latest installation the valve has a separate emergency control in the form of a third lever connecting directly to the cockpit, by means of which the pilot can open the valve at will in the event of an emergency. Recently the composition of Anilol has been changed so that in addition to anti-knock properties it has de-icing properties. In several tests in which so much ice had formed in the carburetor that the inlet manifold pressure had decreased by 3 to 4 in. of mercury, all ice was removed in 15 to 20 seconds when only the normal amount of Anilol required for knock-suppression was injected, and the pressure loss was eliminated.

Another use for Anilol is propeller de-icing. It was suggested that since a supply of Anilol was being carried for the purpose of carburetor de-icing, it would simplify matters if this same tank could be hooked up to the propeller de-icing system, thus eliminating one tank. Tests were made to ascertain whether or not Anilol compared favorably with the alcohol glycerine solutions being use. The de-icing time was found to be identical for both solutions, and it was then found that Anilol was much more easily handled, as the viscosity did not change appreciably at lower temperatures and that it did not clog nearly as readily as the alcohol-glycerine solution.

Noise Reduction

DR. ERNEST J. ABBOTT, of the Physicists' Research Co., Ann Arbor, Mich., presented a paper on a "New Technique for Noise Reduction." This paper was divided into three sections, the first dealing with Concepts of noise and noise reduction; the second with Quieting Methods, and the third with Examples of Practical Quieting.

Sound may conveniently be thought of as a pressure variation in the air. This pressure is usually measured in dynes per sq. cm., which unit gives more convenient numbers than lb. per sq. in. Since the sound pressure is an "oscillating" quantity it is convenient to follow electrical convention and use *r.m.s.* (root mean square) values. The loudness of the sound as heard by the average ear is essentially proportional to this pressure. Second-order corrections are quite large, especially in the case of complex sounds, but it is useful to use this relation as a basis and to consider departures from it as corrections.

In general, the sound pressure generated by a vibrating object is proportional to the velocity of that vibration, and it is, therefore, useful to deal with vibrations in terms of their velocity rather than their displacement and frequency. There are important corrections to this concept also.

Experience shows that to obtain worthwhile reductions in sound level, it is usually necessary to reduce sound pressures and vibrational velocities to one-half or one-third their initial values, that is, to make reductions of 6 and 10 db. respectively. Noise components with pressures two or three times those of other components are easily located and treated, and most practical noise problems in automobiles and other machinery involve as many as four or more components of about equal importance. The basic relations for combining oscillating quantities, such as sound pressures, make it impossible to obtain a large reduction by the elimination of one or two of the components. Therefore, means must be employed which will reduce all contributing components in sizable proportions (two or three to one).

One of the most successful methods of reducing noise consists in reducing velocities by reducing mobilities, or forces, or both. This method of quieting probably finds more application than all other combined.

Sound is radiated from vibrating objects, and this radiated energy is drawn from the source which drives the vibrating object. The greater the sound energy radiated, the greater the resistance to motion of the radiator. Hence, if we can reduce the radiation resistance of a vibrating object, we can reduce noise. The principal factors controlling the radiation resistance of objects vibrating in the air are the vibration pattern of the object and the relation of the wave length of the sound to the dimensions of the vibrating area. In general, sounds can be reduced if the dimensions of the vibrating parts can be made smaller than the wave lengths of the sound being radiated. At 1000 cycles the wave length is about 1 ft.; at 100 cycles, 10 ft.

One of the most effective ways of reducing noise is to place an enclosure around the source or the observer. The enclosure should, preferably, be made of a poor sound absorber, as the noise-reducing effect of such an enclosure is not based on the principle of sound absorption. The absorption coefficient of a sound-absorbing material is defined as the ratio of the difference between the energies per unit of area of the incident and reflected waves to the energy per unit area of the incident wave. The best sound absorbers are soft, porous materials such as hair felt, rock wool, cellulose fibers, cotton, etc. At 125 cycles (which is about the frequency of the largest components of automobile noise) the best sound absorbers have an absorption coefficient of between 0.2 and 0.5. As the fraction of the sound energy pressure remaining after passing through an absorber of absorption coefficient a is equal to $\sqrt[4]{1 - a}$, an absorber having the unusually high absorption coefficient of 0.4 still leaves 88 per cent of the original sound energy, which means that it gives a reduction of only 1 db., which is of little or no practical value. An enclosure consisting of a glass pane ⅛-in. thick, on the other hand, because of its low mobility, would give a reduction in sound level of 23 db. In soundproof rooms partitions are sometimes used which give a reduction in the noise level of 50 db., which means that they transmit only 0.3 per cent of the sound energy.

The effectiveness of an enclosing shell can be increased by a few decibels by lining the interior with sound-absorbing material, but in many cases it is more economical to use a more effective enclosure. Enclosures are of little value, however, if they contain openings of appreciable size. It may also happen that noise is increased, instead of being decreased, by placing an enclosure around a machine. This is the case where the enclosure is in mechanical contact with the machine and is set in vibration directly instead of through the intermediary of sound waves. The enclosure must, of neces-

sity, be supported, and a highly resilient support is necessary to obtain a high degree of effectiveness.

In order to reduce noise effectively by absorption, all of the sound reaching the ear must strike an absorber many times, as it does when passing through a duct or tube which is long in comparison with its diameter. In such cases lining of the duct with an absorbant material does a great deal of good.

Mechanical damping can also be made use of to reduce noise, and is especially effective when there is resonance between the driving force and the vibrating body. However, resonance, as a rule, cannot be tolerated for other reasons, and it is rare that the specialist in acoustics is confronted with a problem in which resonance is a factor. Transient vibrations die away much more rapidly if the panel is treated with damping material, but on the road the driving forces are essentially continuous, and damping of the panels makes little difference. Therefore, aside from cases of resonance and transients, mechanical damping is of little consequence as a quieting means.

While loose machine parts rattle and knock, a reduction in machining tolerances is not a cure-all for noisy operation. For instance, a reduction in the tolerances from 0.001 to 0.0002 in., while very costly, may make very little difference, and even result in no quieting whatever. This is easily understood when the magnitude of accoustical movements are considered. The particle displacement in the sound of 80 db. is approximately 0.00003 in. at 100 cycles and 0.000003 in. at 1000 cycles. Dr. Abbott said that a reduction in machining tolerances should be resorted to only after definite evidence had been obtained that it will produce the desired result at reasonable cost.

It is often suggested that quieting can be accompanied by shifting frequencies outside the range of audibility. In cases of resonance a slight shift in the frequency so as to avoid resonance may be quite effective. Also, to most people the higher frequencies are more objectionable than the lower ones, but for sounds of ordinary level the ear is about equally sensitive to all frequencies from 50 to 10,000 cycles per second, a range of nearly eight octaves, and it is manifestly impractical to change speeds in the ratio of 100 to 1. The general tendency is to increase speeds, and this necessarily increases noise.

Self-Tapping Screws

AN exhaustive analysis of self-tapping screws was given by Ralph H. Upson, in his paper, "The Use of Self-Tapping Screws in Mechanical and Structural Assemblies." Basically, all screws for tapping into metals have at least the following characteristics in common:

1. They are case-hardened.
2. Tip diameter less than main body.
3. Act mainly by indenting the material.

According to the author, self-tapping screws possess the following general advantages:

"1. Compared to other types of screws, they save the separate operation of tapping female threads, or the use of threaded nuts.

"2. The fact that each screw taps its own mating threads insures a close fit, which avoids play in the joints and discharges loosening.

"3. Compared to conventional rivets and welding, screws permit working from one side alone, an important item for tubes, blind sections, and all closed or confined assemblies.

"4. They readily permit disassembly for inspection, repair or other purpose.

"5. The screw is prefabricated in its finished form by a well controlled process, which permits generally higher strength material than rivets, and establishes known conditions for a straightforward stress analysis.

"6. Inspection is simplified by confining its importance to one side; and by the fact that failure of the material around the screw causes loosening and usually unscrewing, which is readily observable in its initial stages before more serious consequences develop."

The paper contains a complete mathematical analysis of self-tapping screw design and application, discussing insertion torque, screw strength, hole size, and other design elements. In addition, there is a section devoted to a discussion of pos-

Octane Number Requirements

J. B. MACAULEY, of the Chrysler Corporation, reported on a survey of the octane-number requirements and vapor-pressure limits of 1937 passenger cars which had been made by a sub-committee of the CFR Committee. The conditions under which the tests were carried out defined the octane requirements of a car as the octane number of the fuel which would give just a trace of knock when the car is accelerated in high gear from 10 to 70 m.p.h. under certain conditions which were also specified. The vapor-pressure limit was defined as the vapor pressure of the gasoline which will produce incipient vapor lock, as indicated by a momentary cutting out of the engine due to interruption of the fuel flow, when the car is operated under certain specified conditions.

The survey reported covered 29 cars of 1937 model. Octane requirements as determined by the tests were corrected to 29 in. of mercury dry-air pressure, and it was found that six of the 29 cars tested with standard spark advance required an octane number of more than 70. With an increase in altitude the octane requirement is lowered, and test results indicated that for altitudes up to 6000 ft. the octane requirement on the average is reduced 3 numbers per 1000 ft.

The vapor-pressure limit was determined under two different sets of conditions, viz., low-speed conditions, with the temperature stabilized at 35 m.p.h., and high-speed conditions, with the temperature stabilized at 70 m.p.h. It was found that vapor lock is most likely to occur on full-throttle acceleration after a stop of 5 minutes following the 30-mile stabilization run. Corrected to standard conditions (100 deg. F., 29.92 in. of mercury) the vapor-pressure limits of the 23 cars tested ranged from 4.2 to 12.0 lb. per sq. in., the average of all values obtained showing an improvement of 1.5 lb. per sq. in. in the Reid vapor pressure over 1936 American passenger-car engines.

sible further improvement in screw design.

According to the author, time studies of airplane-type of structures when applied to bus and truck framing indicate that screws can be inserted at half the cost of riveted construction.

Peanut Oil as Diesel Fuel

EXPERIMENTS on the use of peanut oil in Diesel engines have been carried out in Italy. The physical and chemical properties of the oil were determined and dynamometer and field tests made. The results were compared with those obtained when using A.G.I.P. gas oil, which is widely used in Italy as a Diesel fuel. This comparison led to the following conclusions:

Peanut oil has a high ignition temperature; if it is impossible to preheat the oil and if the atmospheric conditions are such that the temperature of the oil is below 50 deg. Fahr., it is impossible to operate the engine with this fuel.

The viscosity is quite high, especially at low temperatures, and atomization is therefore difficult.

The formation of deposits on the combustion-chamber walls must be attributed chiefly to the fact that when the oil is injected into the cold engine, the liquid fuel is deposited on the walls and oxidizes (or burns) incompletely, leaving a considerable quantity of residue.

Peanut oil attacks copper slightly, and the use of copper tubing should be avoided.

If continued use of the peanut oil in an engine with provision for preheating is contemplated, it is advantageous to increase the injection pressure, by suitably changing the size of the injector orifices, and to readjust the injection pump.

The unpleasant odor of the exhaust gases is unavoidable, and the use of the peanut oil should, therefore, be limited to military purposes.

Oetiker Brake Improved

A NUMBER of improvements have been made in the (French) Westinghouse Oetiker brake for 1938. This, it may be recalled, is an engine brake and consists essentially of valves in the exhaust and air-intake pipes. In the original model the brake was applied by a hand lever. In the new model it is applied by the first part of the motion of the brake pedal, continued motion of the pedal applying the mechanical brake. To disengage the engine brake it is only necessary to step lightly on the clutch pedal. With this new design the engine brake is always applied first, which is of double advantage, as it tends to prevent skidding and does not occasion any wear of brake linings. Moreover, with the Oetiker brake the engine draws in no combustible charge after the brake has been applied, which is conducive to economy. The driver has a series of three different brakes which he can apply at will by the use of his feet alone, leaving his hands free for steering. The three brakes are the idling engine, the engine with inlet and exhaust passages closed (Oetiker brake), and the mechanical brake.

Trolley Buses in London

At the beginning of the current year the London Passenger Transport Board had 766 trolley buses in operation and 616 more on order, a new order for 100 such buses having been placed toward the end of 1937. The rapid introduction of trolley buses marks the disappearance of the old trolley cars.

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